

# Compressed Air

## Magazine



MAY 1959

### IN THIS ISSUE

URANIUM MINING  
HISTORY OF BELLOWE  
PACKAGED STEAM  
CARGO HANDLING  
INDEX AND COVER STORY, PAGE 3

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**ALLEN-BRADLEY**  
**Solenoid Starters give**

**MORE MILLIONS  
OF TROUBLE FREE  
OPERATIONS**

**... and for good reasons**

• **ONE MOVING PART**

With this simple solenoid design, there's virtually nothing to go wrong—all trouble-causing bearings, pivots, and flexible jumpers have been eliminated.

• **DOUBLE BREAK, SILVER ALLOY CONTACTS**

Allen-Bradley silver alloy contacts never require maintenance. They are always in perfect operating condition... and remain so until completely worn away.

• **SIMPLE UP-AND-DOWN MOTION**

The virtually frictionless, straight line vertical motion provides uniform contact pressure at all times—and assures consistent, rapid operation of the contactor.

• **RELIABLE OVERLOAD PROTECTION**

All A-B starters are equipped with two permanently accurate and reliable overload relays that protect motors against "burnouts." Three overload relays can be furnished.



**BULLETIN 709  
STARTERS**  
are made in 9 sizes  
from Size 0 (at left)  
up to Size 8.

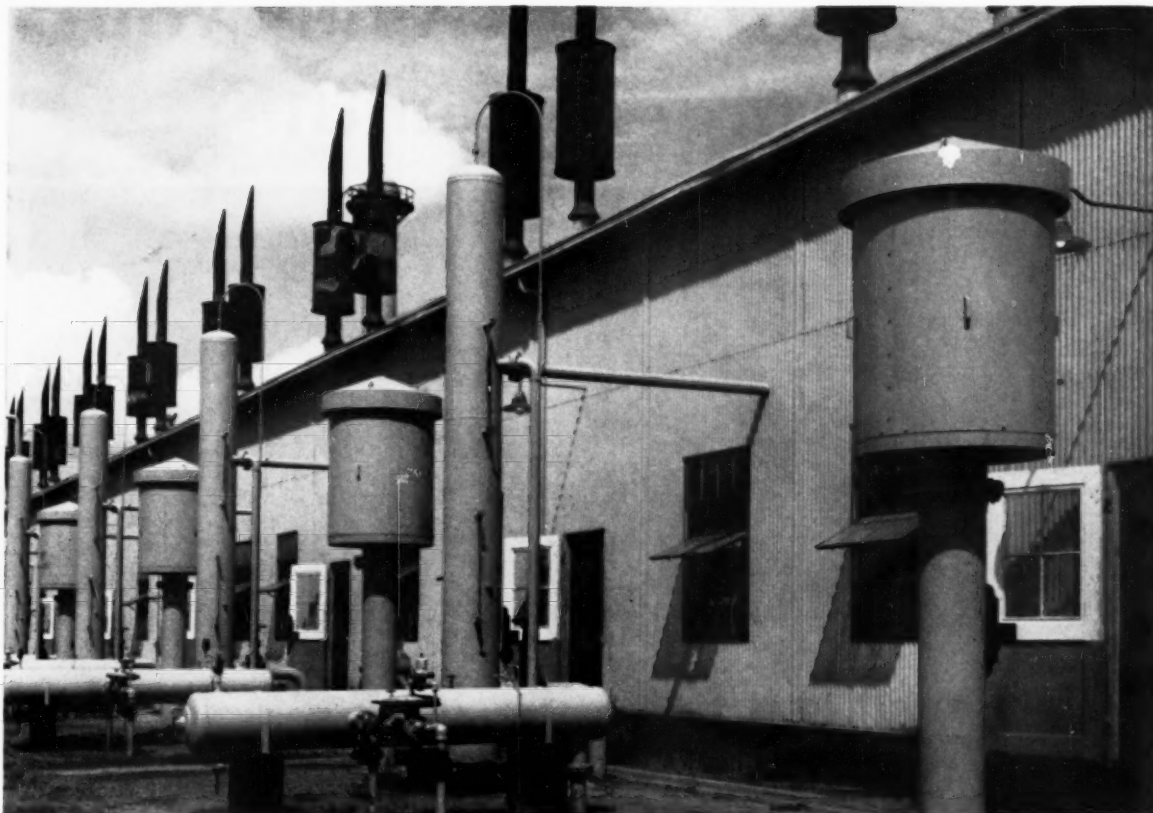
**BULLETIN 709 SIZE 7**  
with maximum ratings of 300  
hp, 220 v, 600 hp, 440-550 v.

**ALLEN-BRADLEY**

Allen-Bradley Co., 212 W. Greenfield Ave., Milwaukee 4, Wis.  
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

**QUALITY  
MOTOR  
CONTROL**





Partial view of a Falfurrias, Tex., gas plant showing four of eight Staynew air-intake filters that are effecting spectacular economies in maintenance costs for La Gloria Oil and Gas Co.

## Filters Function Four Full Years Without Maintenance

In 1952 the Falfurrias, Tex., gas plant of La Gloria Oil and Gas Co. substituted two Staynew air-intake filters for conventional oil-bath filters on two gas-engine-driven, natural-gas compressors.

Two and a half years later the pressure drop through the Staynew filters had increased only to where it equalled the pressure drop of an oil-bath filter *immediately after an oil change*.

Air resistance was not yet enough to warrant cleaning. Therefore, La Gloria left the filters alone for another 19 months before deciding on an overhaul.

Oil-bath filters by comparison had required an oil change every 10 months, each change calling for 60 gallons of oil and high labor costs.

As evidence of its satisfaction with Staynew filters, the company installed four more in 1954, another pair in 1955, and an additional three in 1956 to replace the last of the oil-bath filters.

The efficiency of Dollinger Staynew filters actually increases with use. So why buy filters that require rigid maintenance schedules? Let a Dollinger representative show you how to save time and money with Staynew Intake Filters, or write for Bulletin 100. Dollinger Corporation, 7 Centre Park, Rochester 3, N. Y.



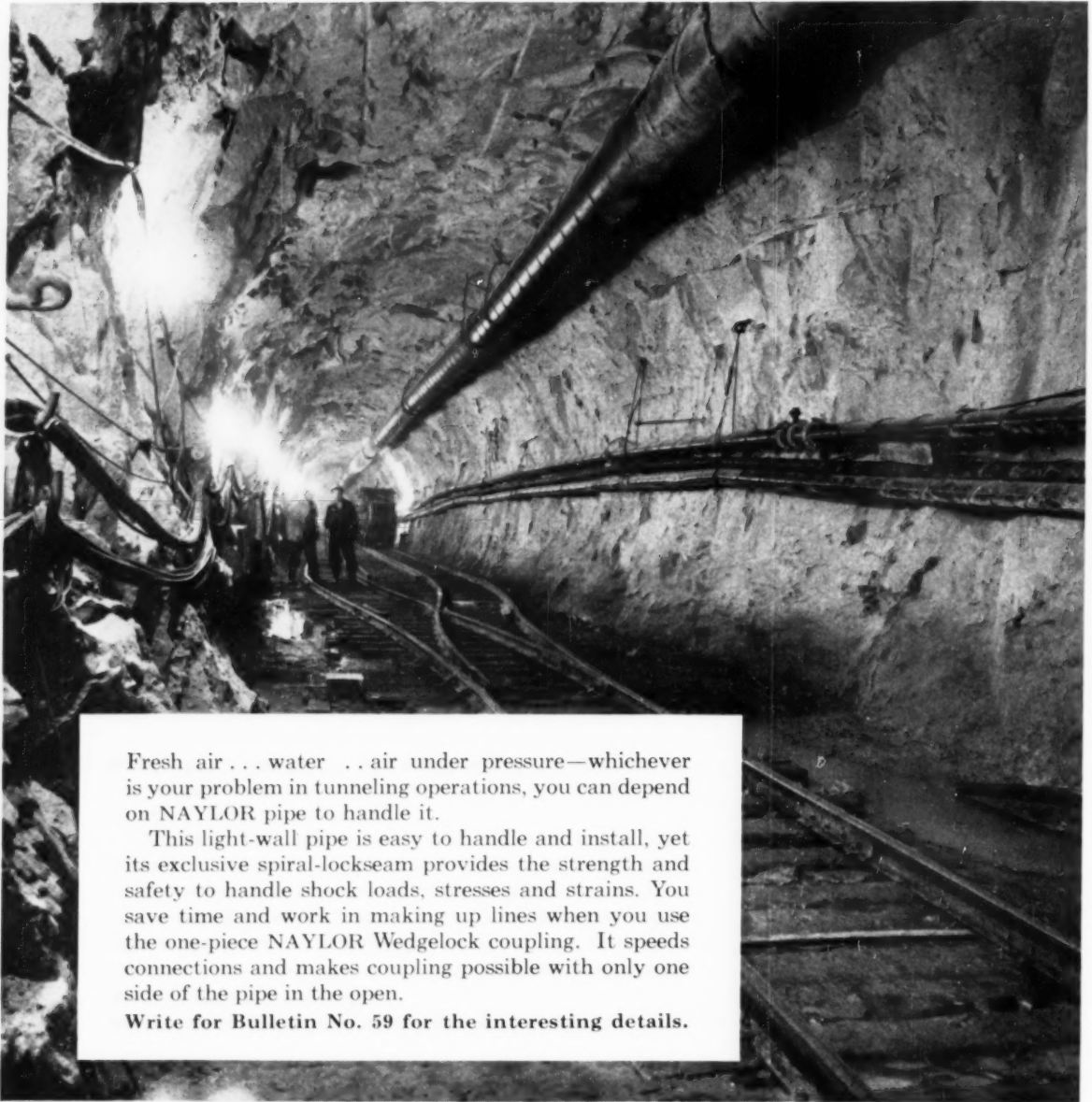
**STAYNEW**

**DOLLINGER**



LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS • AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

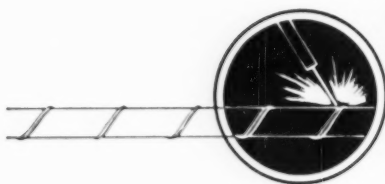
# You Can Take It With You ...Underground!



Fresh air . . . water . . . air under pressure—whichever is your problem in tunneling operations, you can depend on NAYLOR pipe to handle it.

This light-wall pipe is easy to handle and install, yet its exclusive spiral-lockseam provides the strength and safety to handle shock loads, stresses and strains. You save time and work in making up lines when you use the one-piece NAYLOR Wedgelock coupling. It speeds connections and makes coupling possible with only one side of the pipe in the open.

Write for Bulletin No. 59 for the interesting details.



## NAYLOR PIPE *Company*

1245 East 92nd Street, Chicago 19, Illinois

Eastern U. S. and Foreign Sales Office: 60 East 42nd Street, New York 17, N. Y.

# Compressed Air Magazine

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May 1959

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## ON THE COVER

HIGH on the eastern slope of the Continental Divide, near Boulder and Nederland, Colo., lie the ruins surrounding Sam Conger's famed Caribou Silver strike. Ninety-nine years old, the rich vein was found in 1860; but Conger, like most prospectors of the time, could not recognize silver ore and was unaware of the value of his find. Eight years later, however, he saw similar ore in a shipment of great value and set out to retrace his steps of previous years. Eventually he found his claim; some \$20 million in silver is credited to the various operations initiated by the Conger find. The cover illustration shows the remains of a bellows-fanned forge near the old mine. Drill steel sharpened there was used by single-jackers to drill thousands of feet of holes for blasting with black powder.

## FEATURE ARTICLES

### Page 12 Algoma Uranium, Mining Methods—*R. J. Nemmers*

Second in a series of three articles about the uranium strike between Sudbury and Sault Ste. Marie in Ontario, Canada, this month's story details some of the technical aspects of taking the ore from the ground. Methods and equipment used in both track and trackless mining are explained.

### 19 Forerunner Of The Compressor—*C. H. Vivian*

Bellows early established air under pressure as a servant of man, especially in the metal-working industries. This article describes the historical background of bellows and is illustrated with many classic drawings of these early "compressors."

### 23 Packaged Steam—*Robert James*

The essence of steam boilers—a pressure vessel, a heat source, a means of feeding water to the unit, a method of removing the steam—has been elaborated into a new concept of packaged boilers.

### 26 Changing The Silhouette At Sea

A new concept of efficient cargo handling evolved from what is called the Overdeck Siporter. Based on the success of a working model, predictions are for wide-spread use of the loader in marine architecture.

### 28 Ice Cream Manufacture—*Joseph Flamand*

Oil-free compressed air, always an aid to the dairy industry, is being utilized to produce ice cream. It results in less expense and improves quality and purity control.

### 32 Big Truck With Big Problems

Moving a more than 75-foot-long, 300-ton-capacity truck to Spain and reassembling it for operation, caused special handling problems for the manufacturer, the purchaser and the shipper.

## DEPARTMENTS

### 30 This And That

### 33 Editorial—*The Toolbox*

### 35 Saving With Air Power—*Application: Securing Pipeline Bolts*

### 37 Industrial Notes

### 47 Index To Advertisers

G. W. Morrison, *Publisher*  
R. W. Sapora, *Manager*

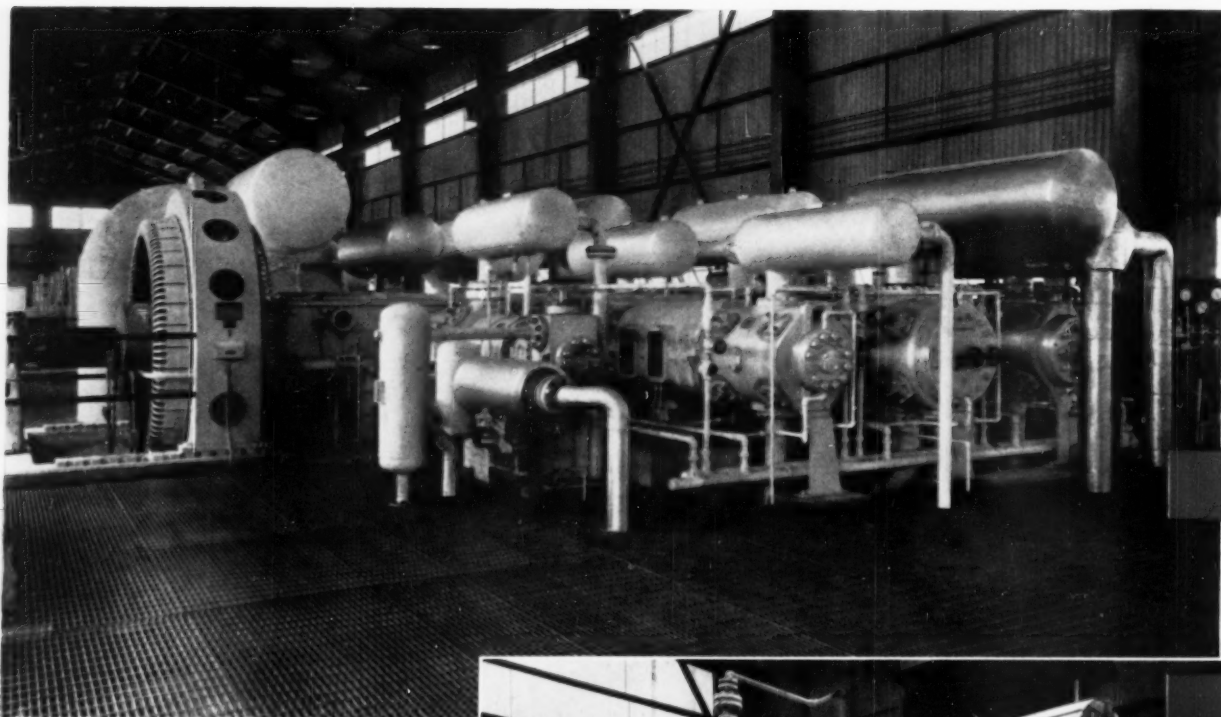
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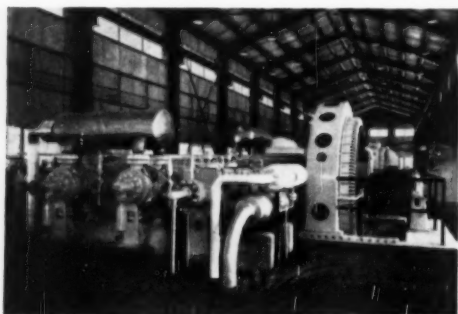


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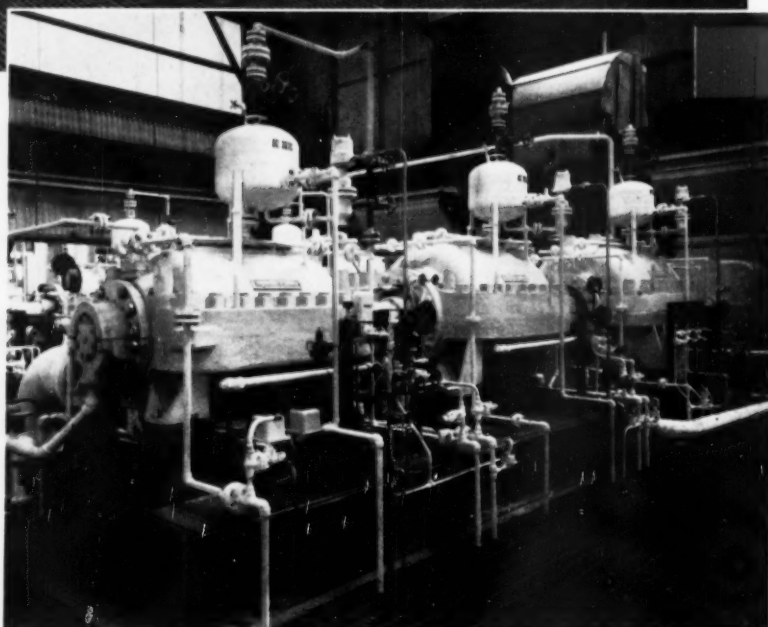




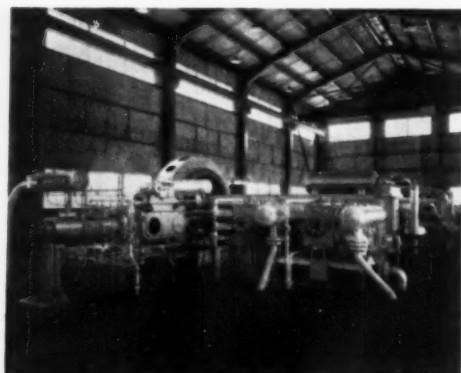
▲ Two 3500-hp HHE compressors in P.C.I. ammonia synthesis plant. Each 12-cylinder unit simultaneously compresses air and nitrogen, each in three stages; ethylene and high-pressure nitrogen, each in two stages; and low-pressure and high-pressure ammonia gas services, each single-stage.



▲ Two 3000-hp HHE hydrogen source gas compressors, each handling waste gases from Platformer, Hydroformer and butadiene plants, as well as ethane and methane residual gases, in eight separate compressor cylinders.

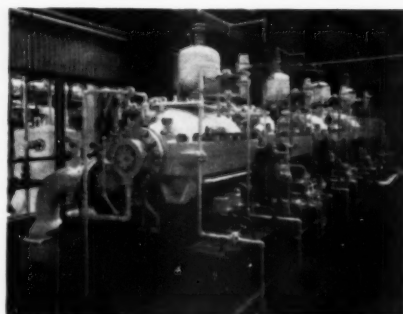


▲ Train of three multi-stage horizontally-split centrifugal units compressing ethylene gas to 396 psi.



▶ Train of four multi-stage horizontally-split centrifugals with gas-turbine drive, compressing 10,750 cfm of hydrocarbon feed gas to 525 psi at the P.C.I. ethylene plant.

◀ Two 4000-hp HHE's compressing ammonia synthesis gas in four stages to 9255 psi.



# Ingersoll-Rand compressors and pumps serve all production processes for **PETROLEUM CHEMICALS, INC.**

Among the world's most ultra-modern processing plants are the new ammonia synthesis and ethylene units of Petroleum Chemicals, Inc., at Lake Charles, La. The adjacent Calcasieu Chemical Corp. plant, newly-built and operated by P.C.I., is a major producer of ethylene glycol. In all three plants, Ingersoll-Rand equipment plays the lead role in pressurizing and moving the gases and liquids that keep these processes going 24 hours every day.

## **8 RECIPROCATING COMPRESSORS in Ammonia and Glycol Plants**

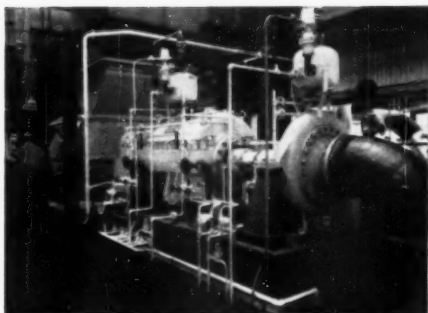
Six multi-stage Ingersoll-Rand electric-driven HHE compressors, totalling 21,000 hp, do all compression jobs in the P.C.I. synthetic ammonia plant. In the Calcasieu Chemical ethylene glycol plant, a four-stage HHE takes 80-psi air from an I-R centrifugal compressor and raises it to 2675 psi. A two-stage PHE compressor handles nitrogen.

## **11 CENTRIFUGAL COMPRESSORS in Ethylene and Glycol Plants**

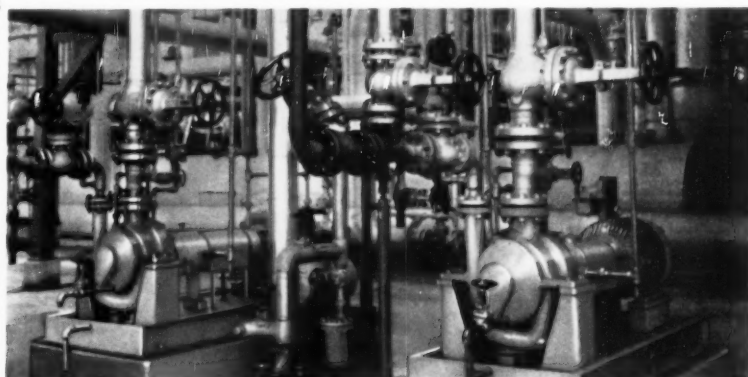
Three trains of I-R centrifugal compressors (nine individual units) are at work in the P.C.I. ethylene plant. Each train is driven at approximately 7000 rpm by a 12,500-hp combustion gas turbine. In addition, there are two I-R centrifugals at the Calcasieu glycol plant: a multi-stage compressor discharging 80-psi air to the reciprocating unit mentioned above, and a single-stage blower boosting 8750 cfm of gas to 202 psig.

## **92 CENTRIFUGAL PUMPS in all three plants**

The 92 Ingersoll-Rand pumps at Lake Charles include vertical and horizontal units in single- and multi-stage construction. They serve in all phases of production, handling cooling water, boiler feed water, light hydrocarbons and synthetic ammonia.



▲ Single-stage and multi-stage centrifugal compressors in tandem, handling propylene at 265 psi discharge.



# Ingersoll-Rand

4-907

11 Broadway, New York 4, N. Y.

COMPRESSORS • ENGINES • PUMPS • AIR & ELECTRIC TOOLS  
CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

FOR PRESSURES UP TO 750 psig . . . . .

## NEW Stainless Steel *Fulflo* FILTER



This rugged, compact filter is ideal for high pressure pneumatic and hydraulic applications. Maximum air flow rate is 650 SCFM at 750 psig with initial pressure loss of 3 psi. Flow rate for liquids of aqueous viscosity is up to 5 gpm, depending on nature of fluid, contaminant and operating conditions.

Patented 10-inch Honeycomb Filter Tubes provide true *depth* filtration through hundreds of filtering tunnels engineered for uniformity of size, shape and depth. Tubes are precision manufactured in a wide range of positively controlled densities to provide the exact degree of micro-clarity your operation requires — even down to 1 micron. Tubes are available in cotton, nylon, orlon, dynel, acetate and glass fibres.

Rugged one-piece shell is made from Type 316L stainless steel. All parts are of #316 stainless steel to minimize chemical reaction. Straight line pipe connections are  $\frac{3}{4}$ " NPT. Overall filter size is only  $13\frac{5}{16}$ " x  $4\frac{3}{8}$ ".

Write for Bulletin S600 to Dep't CA.

**COMMERCIAL FILTERS CORPORATION**

MELROSE 76, MASSACHUSETTS

PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

**MICRO-CLARITY AT MINIMUM COST**



with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.



Selective filtration of oils • water-oil separators • magnetic separators • pre-coal filters • coolant clarifiers • automatic tubular conveyors.



# NEW from EIMCO

## The Eimco 631

## Hopper Loader

**Crawler Mounted**

**Hopper Loader**

**with Greater Capacity**

Latest addition to the famous 630 series of compressed air activated, crawler mounted equipment, with a greater hopper capacity of 45 cubic feet. With an additional 5 cubic feet carried in the bucket, a payload of three tons (50 cubic feet), can be easily handled. The 631 will also be available for AC operation.

The Eimco 631 is self-loading, capable of both loading and carrying material. It is the answer to many and varied problems of developing and production-loading in stopes, drawpoints and other such areas.

Features include special long tracks for maximum stability and ground contact area; a positive semi-automatic hold-device, for holding loaded bucket in carrying position; heavy-duty and removable hopper with full opening door; improved, heavier equalizer bar; new, improved trunnions and brackets and additional track rollers for a crawler base capable of easily carrying these heavier loads.

Contact the nearest sales office or write The Eimco Corporation, P.O. Box 300, Salt Lake City 10, Utah, for all details.

Another product of Eimco's  
"ADVANCED ENGINEERING AND QUALITY  
CRAFTSMANSHIP SINCE 1884"



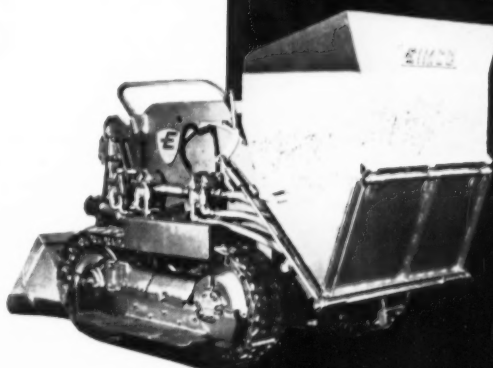
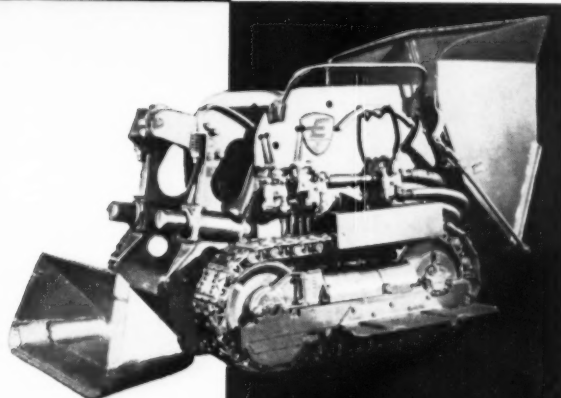
**THE EIMCO CORPORATION**

Export Offices Eimco Building, 51 - 52 South Street, New York 5, N. Y.

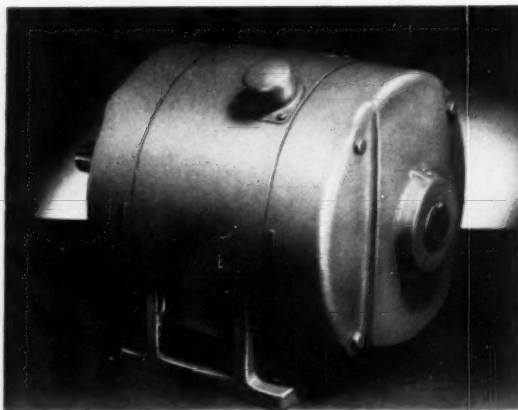
BRANCHES AND DEALERS IN PRINCIPAL CITIES THROUGHOUT THE WORLD

B-411

MAY 1959



**SALT LAKE CITY  
UTAH**



General Electric announces . . .

## **inherent protection for integral-hp three-phase motors for fan, blower, compressor applications**

**U.L. listed, G.E.'s inherent protection for integral-hp three-phase motors is long-awaited breakthrough in guarding against all abnormal operating conditions**

**You can now get a 1, 1½, 2 or 3-hp, 1800-rpm, three-phase motor with U.L. listed inherent protection that will stay on the job, delivering its maximum rated output, without danger of burnout.**

**General Electric's inherently-protected three-phase motor does a complete protection job by providing "built-in" protection against motor overheating under all abnormal operating conditions.**

Engineers at General Electric's Small Integral Motor Department expect that "built-in" protection will virtually eliminate three-phase motor burnout caused by abnormal operating conditions, such as unbalanced voltage, single-phasing, prolonged overloads, stalling, failure to start, lack of ventilation, and ambient temperature increases.

### **SENSES ALL FACTORS**

General Electric has achieved inherent protection for three-phase motors by mounting a protector near the motor windings, where it is sensitive to all factors that cause overheating. The protector is responsive to both temperature and current. This means that inherent motor protection is superior to external-control protection, since controls only protect against excessive motor current.

Nuisance trips or burnouts are eliminated by the protector, because it is calibrated to trip and open the motor circuit at the maximum safe winding

temperature level. Here's how General Electric's inherent protection works:

### **TAMPER-PROOF ASSEMBLY**

The three-phase motor protector has a snap-acting thermal disc, three contacts and three heating elements in a molded phenolic base. The unit is assembled on the motor frame, and protected by a pressed-steel cap. Internal connections are factory made at the neutral point of the three-phase wye-connected motor. (This assembly makes it tamper-proof, a further assurance of permanent motor protection.) An etched, stainless-steel plate, located on the motor frame near the conduit box, provides complete external connection information.

Each of the three protector contacts, and its associated heating element, is electrically in series with the neutral point of the wye-connection and a phase of the motor winding. When the thermal disc snaps open—either from high ambient temperature or from excessive motor current—connection is broken

at the neutral point, interrupting the current in all three phases of the motor. The protector resets *automatically* after the motor cools, and motor operation is resumed with "built-in" protection.

### **EASILY MAINTAINED**

In addition to the significant advance in three-phase motor protection offered by General Electric, the G-E inherently protected three-phase motor has been ideally designed for easy inspection and maintenance. The motor can be disassembled—end shields, baffles, rotor assembly, and bearings can be removed—without disturbing the protector or making time-consuming disconnections.

Manufacturers and users of fans, blowers and compressors can get more information on G.E.'s three-phase motors with "built-in" protection by contacting any General Electric Apparatus Sales Office. Or, information can be obtained from Section 840-27, General Electric Company, Schenectady 5, N. Y. (Ask for A-6932.)

*Progress Is Our Most Important Product*

**GENERAL  ELECTRIC**



**Steel Replaces Wood in Mountain Pipe Line.** More than thirty years ago, the Pennsylvania Power & Light Company built a wood-stave conduit in the Pocono Mountains. Now the old conduit, which ran from Lake Wallenpaupack to a hydroelectric plant  $3\frac{1}{2}$  miles away, has been wholly replaced by an all-steel pipe line. Final "can" section of the new steel line is shown being lowered into position.

The big "can" is 38 ft 6 in. long and has a diameter of 14 ft 1 in. Together with its temporary saddles, it weighs approximately 20 tons. Handling this and similar heavy loads was a job for Bethlehem wire rope—always a dependable performer. Bethlehem slings were also used in the rigging, so that every lift could be made with complete assurance.

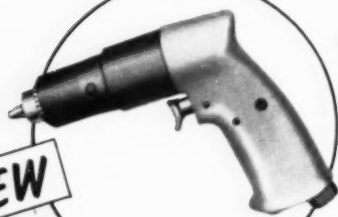
Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation.

*Mill depots and distributors from coast to coast stock Bethlehem Wire Rope.*

**BETHLEHEM STEEL**







**002 Series Drill**  
36% more output... for  
\$1800 Dividend Dollars/year.



**1A Series Drill**  
33% more output... for  
\$1650 Dividend Dollars/year.



**000 Series Drill**  
10% more output... for  
\$500 Dividend Dollars/year.



**01 Series Drill**  
44.4% more output... for  
\$2220 Dividend Dollars/year.

**4**

## NEW SERIES DRILLS...

**NEW** designs **NEW** speeds **NEW** power to give you an  
**ANNUAL DIVIDEND on your PAYROLL DOLLARS**

If your operators are using older model drills, you can increase their man-hour productivity by as much as \$2220 Payroll Dollars in one year, just by replacing the older tools with these new, more efficient I-R tools.

Multiply these *Annual Dividends* by the number of drill operators in your plant, and you can see why management today is taking a new look at portable tool operations.

There's a fast, easy way to calculate the amount of *Dividend on Payroll Dollars* these new I-R drills can help you earn in just one year—without adding to your present payroll.

It's yours without obligation. To get it, call your I-R AIRengineer today. Or write Ingersoll-Rand, 11 Broadway, New York 4, N. Y.

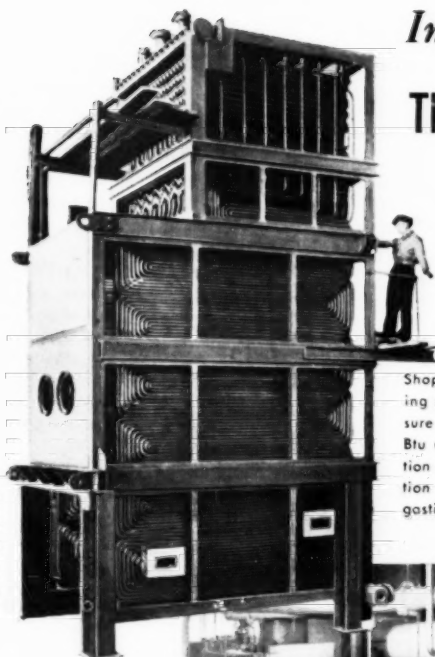


# Ingersoll-Rand

Tools plus AIRengineering  
increase output per man

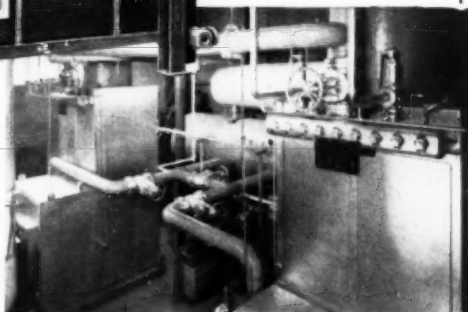
*In new plants large and small...*

## The C-E High Temperature Water Boiler offers savings of 10 to 20%



Shop-assembly view showing steel frame and pressure parts for 25-million Btu unit prior to installation of refractory, insulation block, and welded gastight casing.

Compactness of C-E HCC Boilers is demonstrated in this view of two 10-million Btu units installed at a new Michigan high school.



The list at right points up the versatility and widespread acceptance of Combustion Engineering's HCC boiler. For industrials, schools, institutional use, military bases — wherever there is extensive space to be heated — C-E high temperature water has a place.

Featuring the same principle applied by Combustion in many of its large utility boilers, the C-E LaMont Controlled Circulation Hot Water Boiler offers a compact and effective arrangement of heating surfaces. This design gives precision temperature control, and, dependent upon local conditions, the HCC can save 10 to 20 per cent in maintenance and operating costs — a significant factor when considering a heat source.

Available in a wide capacity range — from 10 to 300-million Btu's — these boilers operate at water pressures up to 500 psi and temperatures to 470 F or higher. The smaller capacity HCC's are completely shop-assembled, while the intermediate and large units are shipped in varying stages of assembly. This C-E practice greatly reduces erection costs.

If you are in the market for boilers, either for space heating or process requirements, it may prove greatly to your advantage to investigate C-E high temperature water as your heat source.

Because individual needs vary, *both* steam and hot water have their applications. Combustion Engineering can furnish either, and our engineers are exceptionally qualified to discuss *impartially* with you or your consultants the method most suitable for your situation.

Write for further details on Combustion Engineering's High Temperature Water Boilers.

### Representative list of C-E HCC Boilers in service, under construction, or on order

	No. of Units	Normal Output ea. Btu Hr. (millions)	How Fired
A. E. Smith High School Riverview, Michigan	2	10	Oil
J. Bishop & Co. Malvern, Pa.	1	12	Oil
Colorado State College Greeley, Colo.	1	60	Oil — Nat. Gas
Cross Company, The Frazier, Michigan	2	12	Nat. Gas — Oil
Defense Construction Ltd. Camp Gagetown, N. B., Canada	3	70	Pulv. Coal Gas
Erie Mining Company Aurora, Minn.	2	65	Stokers — Oil or Gas
Convair Astronautics Div., General Dynamics Corp., San Diego, Calif.	2	30	Oil — Nat. Gas
General Motors Overseas Santos, Brazil	1	12	Oil
Hillcrest Medical Center Tulsa, Oklahoma	1	30	Nat. Gas
Marquardt Aircraft Co. Ogden, Utah	2	12	Oil — Nat. Gas
Michigan State University Oakland, Michigan	1	12	Oil — Nat. Gas
New Florida State Prison Raiford, Florida	2	30	Oil — Nat. Gas
North Carolina Wesleyan College Rocky Mount, N. C.	2	18	Oil — Nat. Gas
U. S. Air Force Academy Colorado Springs, Colorado	3	100	Oil
U. S. AIR FORCE Clinton County Air Force Base Wilmington, Ohio	2	30	Nat. Gas
Dover Air Force Base Dover, Delaware	1	16	Stoker
Forbes Air Force Base Topeka, Kansas	3	50	Oil — (Fut. Coal)
Grand Forks Air Force Base Grand Forks, North Dakota	3	42	Oil — Nat. Gas (Fut. Coal)
McGuire Air Force Base Wrightstown, N. J.	2	25	Stokers — Oil
Minot Air Force Base Minot, North Dakota	2	50	Stokers — Oil
Plattsburgh Air Force Base Plattsburgh, N. Y.	2	110	Oil — Nat. Gas (Fut. Coal)
Portsmouth Air Force Base Portsmouth, N. H.	1	30	Stoker
Wright-Patterson Air Force Base, Dayton, Ohio	2	25	Stokers
Wurtsmith Air Force Base Oscoda, Michigan	3	43	Oil
Air Force Base Torejon, Spain	2	15	Oil
U. S. Navy Auxiliary Air Station Fallon, Nevada			

## COMBUSTION ENGINEERING



C-1908

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

**T**HE YEARS 1962-63, when mentioned in the Elliot Lake uranium area, have but one meaning. It is then that current milling contracts with the Crown expire and the various mines and mills must seek their own markets, not only competing among themselves, but with producers in the United States, the Union of South Africa, the Belgian Congo, others in Canada and smaller mines the world over. Of the free world's then anticipated annual production capacity of 40,000 tons of oxide, it now appears that about 5000 tons will not be required.

These figures predicate a campaign to build mining and milling efficiencies and cut waste, because the contract prices awarded 5 years ago in the scramble for productive capacity almost certainly will be reduced somewhat by competition. Already one mine in the area has been closed: Spanish American, smallest of the three mines in the Northspan group has been mothballed because management deemed it better to let her sister mines and mills fulfill her contract by operating at peak capacity, rather than

having all operate at something less than top efficiency.

The prices now in effect for uranium oxide—the yellow output of the mills—remain confidential but are generally recognized to be about \$10 per pound. The philosophy under which the contract amounts were set was one of enabling the mines and mills to recover development costs and interest prior to expiration of the contracts and also to enable some return to be made on the stockholders' investments. Although merely informed speculation, most producers are looking forward to a price of \$8 per pound, the United States Atomic Energy Commission's option price on the post-1962-63 output of the eleven mines and mills.

Current costs of mining and milling in the area vary from approximately \$10 to more than \$13 per ton, including in some cases some development costs. The average oxide recovery works out to be about 2 pounds per ton. It is obvious that at anticipated post-1963 levels, there remains but a small margin of profit. Current campaigns are aimed at

increasing this margin by reducing the cost per ton to approximately \$8.50 to \$10, or to something less than \$5 per pound of oxide. Some mines having zones of high-grade ores may be able to operate for a time at lower costs, but in general it is felt that the area average of slightly more than 2 pounds per ton will govern cost factors. Milling recoveries of more than 92 percent are now being obtained, or are within sight, for all of the properties.

That the management and employees of the mines are confident of finding markets, and of being able to compete for them, is evident in the continued investment in the area. The Development District of Elliot Lake, described in the first part of this series, is not the sort of mining camp erected for the short term. Average reserves in the Algoma field are expected to last for 25 years or more, and by 1970, it is anticipated, the now foreseen 1960's oversupply of uranium will be reduced by growing demands, prices will again rise and the search for productive capacity will again be underway.

# ALGOMA URANIUM

Mining

Methods

R. J. Nemmers

**W**HEN the mines were staked, uranium was in short supply. Reserves in the United States and Canada were insufficient to supply essential military needs to say nothing of possible commercial applications. Thus came about a costly rush to push the mines to producing status.

In the scramble to get ore out of the ground and into mills, extensive drilling of test holes from the surface was bypassed, consequently data about the exact nature of the ore beds were not available at the time mining methods were being planned. As an illustration of the effect on costs, four mines that had originally used trackless mining equipment (including Spanish American) have been, or are now being, converted to conventional track haulage. At the camp there are now but four mines that can be called trackless operations, and one of these utilizes both tracked and trackless haulage. Three were originally planned for track operation.

## Trackless Mining

Algom Nordic, in part, Stanrock, Can-Met and Consolidated Denison are the mines using the trackless system. Algom Nordic is probably the least faulted of all properties; no major discontinuities have shown to date. The Nordic ore bed is served by a single 14x17-foot 2-compartment shaft. Crosscuts from the different shaft horizons are driven in waste to main 10x14-foot haulageways, carried on strike in the ore. To develop ore blocks, two 5x7-foot slot raises separated by a 10-foot pillar are driven up-dip (10 to 14 degrees) to interconnect the haulageways. Each serves a 65- to 100-foot stopping span, 300 feet in length and 11 feet wide (thick). Although it was originally planned to use 2- and 3-boom tracked jumbos for drilling in the stopes, Nordic now uses jack leg drills with 12-foot steels almost exclusively.

Muck is scraped into shuttle cars over

timber ramps with 30- and 50-hp electric slusher hoists, as well as being loaded with Eimco and Michigan loaders. The shuttle cars carry the muck to ore passes recently put in and located 1500 feet on both sides of the shaft crosscut. (These ore passes at the extremities of the mine are the major modifications of the original plan for Nordic, and were added to reduce travel distance of the trackless equipment to more economic levels.) On the bottom level, muck is transported with mine cars and locomotives to a 36x48-inch Traylor crusher. Crushed rock is conveyed to the surface by a Canadian Ingersoll-Rand 120x54-inch 600-hp hoist handling a 7-ton skip at 1000 feet per minute.

Mine air for Algom Nordic is furnished by three C I-R 500-hp XVH-2 compressors of 2790-cfm capacity each at 110-psig pressure. Mine ventilating air is supplied at a rate of 200,000 cfm, and there is an installed heating capacity of 12 million Btu per hour. Four



### CONVEYOR HAULAGE

In the trackless operation of various mines in the Elliot Lake field, conveyors play important roles on grades steeper than can economically be handled by the trackless shuttle cars and other conveyances, as well as in reducing the travel distance required of the wheeled equipment. In the picture at the right, an Autocar shuttle is shown in discharge position at a 42-inch main incline belt in one of the uranium mines.



### WHEELED HAULAGE

The picture at the left shows a Chasemide dumper in use at the trackless Algom Nordic mine. A variety of equipment is in use in the trackless operations for ore handling, ranging from this 4-ton unit to the Autocar shuttle illustrated at the top. The right illustration shows the haulage method in track mines. The installation is at the Pronto

property, where 24-inch gauge track is laid. In most of the other mines, the track gauge is 30 inches. Ore cars in the region vary from 54- to 140-cubic-foot capacity. The smaller sizes are most often used for footwall drift development work and the larger ones are utilized for ore transportation duties.

75-hp. centrifugal pumps handle de-watering chores.

Stanrock Uranium Mines Limited was planned for trackless mining from the start and underground conditions have borne out original thinking. The ore dips an average of 14 to 18 degrees. Stanrock is served by two shafts approximately 225 yards apart, one being used solely for production, the other for service. Ore blocks are brought into production in conventional room-and-pillar fashion, haulageways being in the ore, on strike, and the stopes having a nominal span of 25 to 30 feet, a length of 250 feet and a width of 11 feet. Drilling is taken care of by 3-boom jumbos working up-dip. Muck is loaded by Trax-cavators and Michigan loaders into the haulage equipment, which in turn dumps to a trench where it is scraped to a load-

ing pocket by a 125-hp slusher hoist.

The production (ore) hoist at Stanrock differs from those installed elsewhere in the area in that it is a friction-type unit. Manufactured by Canadian Ingersoll-Rand Company, its cable is not wound onto the drum. Instead, two 15-ton bottom-dump skips are suspended from a pair of cables that merely pass over the hoist wheel. The friction of the ropes on the wheel is sufficient to enable the lifting of the loaded skip in counter-balance with the downward traveling empty unit. The shaft is a 10x21-foot, 3-compartment opening, with hoisting taking place in two compartments. The 157-inch diameter of the hoist drum matches the center-to-center distance between tracks of the two skips and the drum is mounted directly over the shaft so that no guide sheaves are required for the ropes. The 2500-hp hoist has a speed

of 1500 feet per minute. The production shaft is sunk through a bluff standing 230 feet higher than the collar of the service shaft. Mill crushing equipment is located in hollowed-out rooms within the bluff. There are also storage areas within the rock to hold crushed ore.

The service hoist is a Canadian Ingersoll-Rand 144x84-inch unit handling a man-cage at 1800 feet per minute hoisting speed. Three C I-R 31½x19x14½ XVH-2 600-hp compressors supply 3300 cfm of compressed air at 110-psig pressure to the mine. An underground ventilating station having a capacity of 200,000 cfm is installed. Three 200-hp pumps handle mine water.

Can-Met's mine has been developed as a double-entry, room-and-pillar working. Stopes are 200 feet long, have a span of 25 feet and a maximum width or thick-



### JUMBOS

These two pictures show the type of drill jumbo often used in operations in the Algoma area. The one above was one of two such units that worked at the Buckles mine—a property just south of Algoma Nordic that was worked by Spanish American before its principal mine came into production. The small ore body was mined out by October of last year. This jumbo and its companion unit were utilized in the extraction of about 250,000 tons of ore. Another approximately 15,000 tons were extracted by air leg drills from the fringes of the ore bed. The Canadian Ingersoll-Rand-built jumbo mounted three DA35 drifters on Hydra Booms. The other picture shows one of four 3-boom Canadian I-R jumbos working in the stopes at Panel mine. The drifters utilize 1 3/4-inch tungsten-carbide-insert bits and 1 1/8-inch round steel.



### JACKLEG

Although many jumbo drills were put into operation at the start of mining in the Algoma-Elliot Lake field, some have given way to, or have been supplemented by, lightweight Jackleg drills. This is due to underground conditions that could not be foreseen. Lower headroom, steeper grades and more faulting than expected are factors in the change. Shown in this view is a Canadian Ingersoll-Rand JR-38 unit being used to drive a slot raise in one of the stope mines.

ness of 16 feet. Served by twin shafts, the mine utilizes portable wheeled slushing ramps for loading into shuttle cars. These ramps mount slusher hoists of 30-hp rating and are positioned at the stope entry in the haulageway. Sheaves are rigged and the ore is scraped to the ramp and onto it, finally dropping through an opening into shuttle cars positioned beneath it. The shuttle cars haul to a 42-inch conveyor belt (in the crosscut between shafts), which relays muck to the production shaft for hoisting. The lift is a Canadian Ingersoll-Rand 144x72-inch 1250-hp unit handling a 9 1/2-ton skip at 1325 feet per minute.

Mine air for Can-Met is furnished by two C I-R units of the same size and capacity as the Stanrock air plant. Ventilation fans having a capacity of 205,000 cfm are installed, with an 8,000,000-Btu-per-hour heating plant. A 4-pump mine-dewatering station equipped with I-R 3-stage CNTA-6 pumps is located at the foot of the service shaft.

**Consolidated Denison**, with its rated 6000-ton-per-day mill, is the free world's, and probably the world's, largest uranium mine. The area of the property is 3x1 1/2 miles and contains two ore beds, one above the other. The uppermost has an estimated 50 million tons of ore in reserve—the lower, almost 140 million tons. The reserves so far sampled average 2.78 pounds of U<sub>3</sub>O<sub>8</sub> per ton with some pockets of high grade.

The mine was planned for room-and-pillar mining from the start, using trackless equipment for ore haulage. The

original methods are still largely in force. The upper ore seam is being worked in conjunction with the lower only near Shaft 1. At Shaft 2, only the lower seam is being extracted now, future plans calling for the removal of the upper seam by box holing, using the worked out lower seam for transportation. The beds have a composite 19-degree dip.

A pair of parallel on-strike headings, 45 feet apart and at right angles to a main, 5-entry system between the two shafts, serve each panel at a breadth of 250 feet. One heading, the larger and production opening, is 25 feet in width by the full height of the ore. From it are exploited rooms of 25 to 45 feet in width, pillars of 20-foot width being left between the rooms. The smaller (16x12 feet) of each set of headings is kept ahead of the production openings to obtain foreknowledge of ground conditions and ore grades. In the ventilation scheme, the larger, production, openings serve as fresh airways; the smaller, as return airways. In addition, these lesser headings serve as haulageways to bypass mining and stope preparation areas. Hauling along these on-strike headings is done by either 14-ton electric shuttle cars or 10-ton diesel trucks.

Stopes are mined up-dip by jack legs and are mucked with scrapers. Boom jumbos, mounting three drills, are used in the thicker sections of the ore beds to drill off-strike headings, front end loaders being used to muck them out.

The Denison mine makes the most extensive use of conveyors in the area. From Shaft 1, three 42-inch belts radiate



to the northwest, to the south and to the southwest. These belts are advanced as required to keep the travel of the shuttle cars to a nominal 1000 feet. In the area of Shaft 2, two belt systems discharge into the ore pass. A single belt serves the down-dip area and to the south, and will eventually be extended to 2000 feet in length. The other system of belts will form the main artery to Shaft 1, and will enable all ore to be hoisted through Shaft 2. There will be three flights of 48-inch belts, two of which are now installed. These are the only belts placed in the footwall of the ore. This was done because the ore dip was in excess of what is considered the practical limit for conveying down-dip. From this system of conveyors will be mined all ore between the two shafts for 1500 feet on either side.

The mine is served by five 600-hp Canadian Ingersoll-Rand 3300-cfm XVH-2 compressors delivering air at a nominal 110-psig pressure. Shaft 1, a 14x17-foot, 6-compartment opening, is equipped with a 144x78-inch Canadian Ingersoll-Rand 1250-hp hoist for production, and a 72x60-inch C I-R unit for service. Shaft 2, 16x28 feet with 8 compartments, has two 144x84-inch production hoists, and one of the same size for service—all three also of Canadian Ingersoll-Rand manufacture. The ventilation equipment has a total air capacity of 250,000 cfm, and a heating capacity of 12-million Btu's per hour. A 2-pump dewatering station (300-hp I-R 3-stage CNTA-6 units) is installed in each shaft.

## Track Mining

Algom Quirke, Pronto and Milliken Lake were planned from the start as track haulage systems. The three mines of the Northspan group—Lacnor, Panel and the now-mothballed Spanish American—started as trackless operations and have been, or are being, converted to forms of track haulage. The remaining mine, Stanleigh, is also converting from trackless, but on a more gradual basis.

The merits of track versus trackless methods will undoubtedly be argued for years to come. Basically, however, it is considered that wherever the ore dips more than 10 to 20 degrees, or where extensive faulting has taken place, track methods are most economical. For lesser underground grades, and largely faultless ore bodies of uniform thickness, trackless methods may be the cheaper. There is also a large "shadow" zone where the question cannot be resolved except by experimentation. This is the case with many of the Algoma area mines.

Algom Quirke ore dips an average of 32 degrees. The mining method there calls for open stopes, nominally 65 feet in span, 250 feet long and a width the thickness of the ore bed, or about 11 feet. To develop ore blocks, footwall drifts are driven 25 to 30 feet below the ore, box

holes and manways being raised to the ore bed at 150-foot intervals and steel ore chutes installed. Two slot raises, 8x6 feet and 250 feet long (one on either side of a 10-foot pillar), are driven in ore up-dip from the chute raises to a drift in the ore at the next level. The stope is then mined down-dip by slashing with jack legs from the slot raise, first on one side of the pillar, then on the other. A single slusher installation serves both stopes, scraping ore to the chute raise where it is delivered to ore cars in the footwall drift. Ore is crushed underground in a 36x48-inch Traylor unit of 150-hp.

Quirke is a single shaft working, the opening being 14x17 feet and divided into 6 compartments. Two C I-R hoists of 120x54-inch size serve the mine, the production hoist being equipped with a 600-hp motor to handle a 7-ton skip; and the service hoist, with a 350-hp motor to handle a 30-man cage. The compressed air plant has three C I-R XVH-2 500-hp units having a total capacity of 8370 cfm at a nominal 110-psig pressure. Approximately 494,000 cfm of ventilation capacity is installed with a heating plant rated at 16 million Btu per hour. Four 75-hp centrifugal pumps are installed to handle negligible water inflows.

Pronto's mining method resembles that of Algom Quirke in most respects. The ore dips an average of 30 degrees and



## ROOF BOLTING

Proper support of roofs is important in the Algoma region because of the brittle nature of the conglomerate beds. Open spans in most of the mines have been reduced in size, somewhat, in comparison to early practices. Roof bolting is one method of support practiced to a degree by all of the mines, although its extent depends, of course, on local conditions. The bolts used are almost universally of the expandable type and 6 to 7 feet in length. Ties and plates are used as required. This picture shows the use of a bucket of a front end loader as a platform for roof-bolting work in the Algom Quirke mine. The wrench is an Ingersoll-Rand Size 534 Impactool.



### ROOM SLUSHING

Slushing in rooms is done either by slushers mounted on timber ramps or by portable ramps and slushers as shown in the picture at the right. A Landis unit, it mounts a Canadian Ingersoll-Rand 30-hp, 3-drum hoist. The scraper is pulled to the ramp and onto it, where the muck is dropped through an opening into a waiting shuttle car. As each round is mucked out, the portable ramp may be easily moved to the next room.



### STOPE SLUSHING

In stopes, slushing to ore chutes is almost always used. As shown in the other pictures, the slushers (most are 30- or 50-hp, 2- or 3-drum units) are placed behind the ore chutes, often being protected by a timber barricade. At Algom Quirke where the pictures below and at the left were taken, a single 3-drum Canadian Ingersoll-Rand slusher installation and one chute serve what may be called either two stopes separated by a pillar, or a single stope with center support. Quirke has been experimenting with timber cribs in preference to the center pillar support

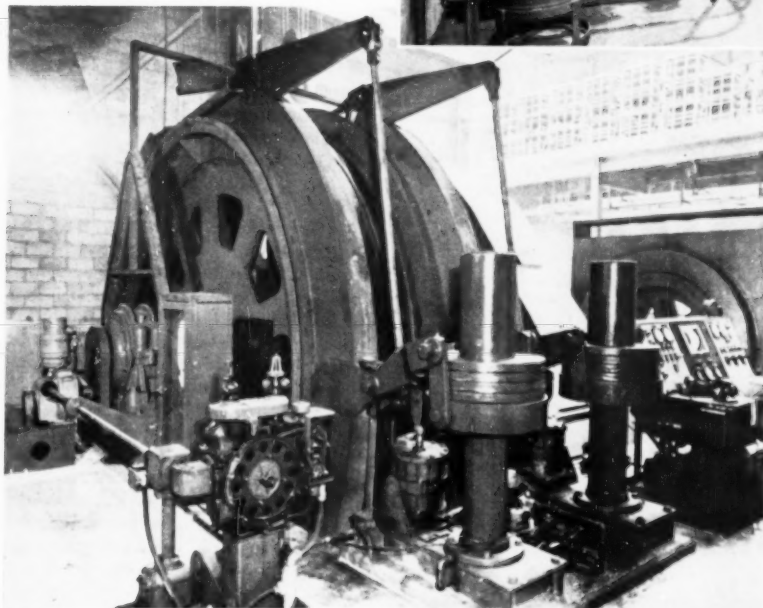
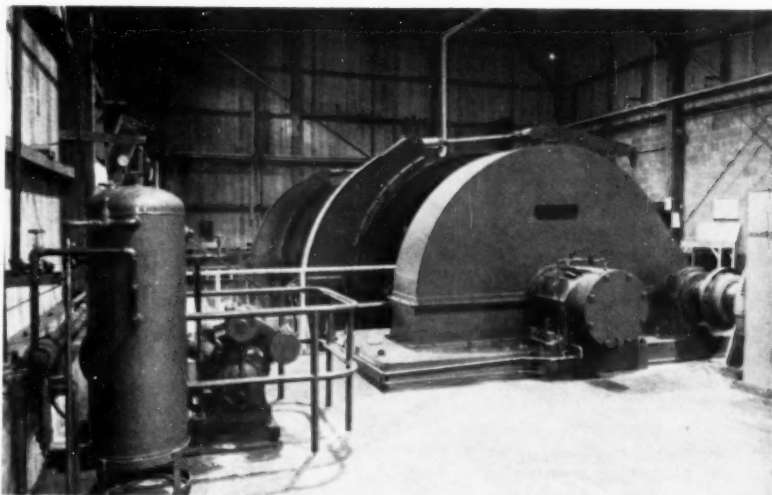
development work is similar. A double stope span is 160 feet divided into two sections of about 70-foot span, separated by a pillar, versus Quirke's 150-foot double span and open sections of 65 feet. In mining the stopes, the Pronto bed is taken in successive cuts across the span, working up-dip, rather than slushing down-dip as at Quirke. The ore at Pronto is relayed to a loading pocket at the foot of the single 8x19-foot 3-compartment shaft and taken to the surface for primary crushing. The mine is served by a C I-R 100x54-inch hoist of 500-hp rating handling a combination skip-cage. The skip takes a load of 4 tons; the cage accommodates nine men. The air plant at Pronto consists of one 1500-cfm unit, and two 1590-cfm XVH's. Ventilation capacity aggregates 197,000 cfm with an installed 4,000,000-Btu-per-hour heating plant. Two 250-hp centrifugal pumps are used for dewatering service.





### DRUM HOISTS

The predominate number of hoists in the Algoma-Elliott Lake mines are Canadian Ingersoll-Rand Class PE-1 units of the general type illustrated in the picture at the right. Drum sizes vary from 72x60 inches to 144x84 inches; horsepower ratings, from 350 to 3000. Two mines utilize single hoists both for ore lifting and service, making use of combination skip cages. The remainder have separate units for each function. This picture also points out another important use of compressed air, the small Ingersoll-Rand Type 30 compressor shown in the foreground being used to furnish air for hoist controls (clutches and brakes). The hoist is a 120x54-inch unit installed at Algom Nordic.



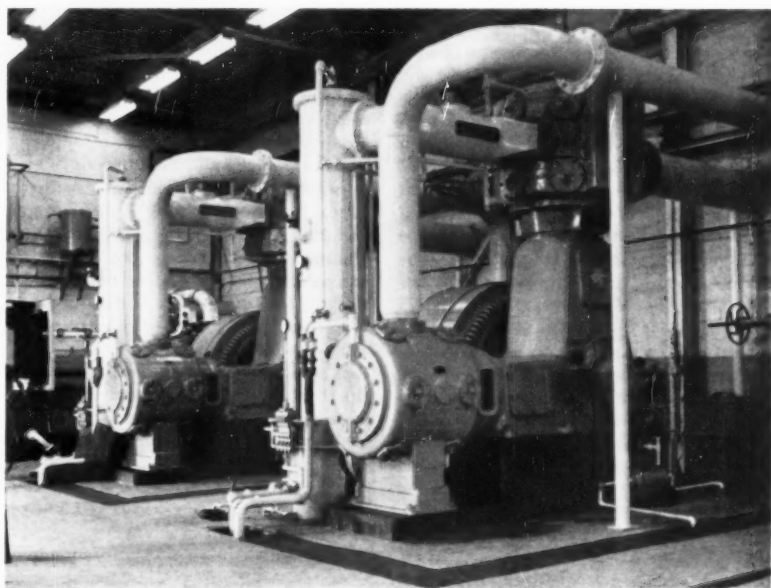
### FRICTION HOIST

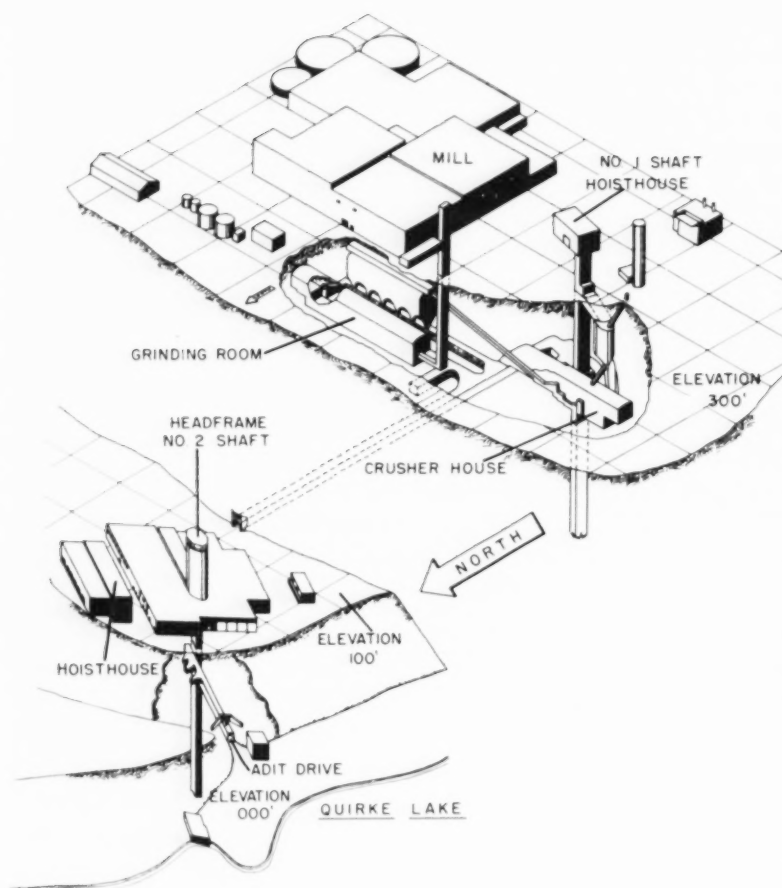
The major departure from the standard, drum-wound, PE-1 type, is the unit at the left, a friction-type hoist installed at Stanrock's production shaft. Cable is not wound on the drum or wheel of this 157x28-inch Canadian I-R unit. Instead, two skips are suspended at the opposite ends of the hoist cables and the cables merely pass over the drum, friction being sufficient to raise one loaded skip in counterbalance with the descending empty one.

Milliken Lake Uranium Mines has two ore seams—an upper one of 10- to 15-foot thickness and a lower, of 6 to 8 feet. A "footwall" drift is driven on strike in the lower seam with boxholes raised at 40-foot intervals to the upper one. In the upper seam a stope raise is driven to the next level along the footwall and then slashing is utilized to widen the stope to about 40 feet. The ore is slushed from

### FAVORED COMPRESSORS

Shown here are two of the three 29x18x14½-inch Canadian Ingersoll-Rand XVH-2 compressors serving Algom Nordic in the mine. Compressors of this type deliver virtually all of the mine air used in the eleven mines in the Algoma field. Thirty-two of these units ranging in size from the 500-hp machines shown, up to 600 hp and down to 300 hp, are installed. The XVH's, all driven by direct-connected electric motors, furnish a total of 92,438 cfm of the total mine air supply of approximately 94,000 cfm.





**SURFACE AND SUBSURFACE PLANT, STANROCK URANIUM**

the upper level through a chute to the haulage drift below. In mining the lower seam, slushers scrape the ore to ramps, thence directly into the ore cars. At the foot of the production shaft, ore is crushed in an Allis-Chalmers 36x48-inch crusher and conveyed to the surface in a 9-ton bottom-dump skip by a C I-R 144x78-inch hoist rated at 3000 hp and with a rope speed of 2500 feet per minute. Both the production and service shafts are 10x21-foot openings, the former having two compartments, the latter three. The service hoist is an identical 144x78-inch unit, but of 1500-hp rating. It handles a 50-man cage at a speed of 1500 feet per minute.

The air plant at Milliken Lake, also made up of Canadian Ingersoll-Rand XVH's, has three 500-hp machines, each delivering 2790 cfm at 110-psig pressure. Ventilation fans have a total capacity of 597,000 cfm. Four Ingersoll-Rand 250-hp pumps handle any water inflow.

Lacnor mine is now operated on a track

basis with underground development of its two parallel ore seams much like the Milliken Lake mine. Haulageways are driven in the footwall with boxholes and manways raised to the ore at stope-width intervals. From these, slot raises are driven in the bottom seam up-dip to the next level and the stope developed by slashing with air leg drills from the raise. Stopes are about 30 feet in span and 200 feet long. Ore is slushed to the chutes and delivered to ore cars in the haulageway below. After posting with timber, the upper seam is removed.

Lacnor produces from both shafts, each of which is a 4-compartment 9x29-foot opening. Shaft 1 handles most of the production, being served by a Canadian Ingersoll-Rand 144x78-inch 2500-hp hoist handling a 9-ton bottom-dump combination skip-cage. The hoist at Shaft 2 is a C I-R 120x66-inch unit of 700-hp lifting a 5-ton skip-cage. The ore is hoisted without crushing.

The Lacnor mine air plant is made up of three 2790-cfm XVH-2 compressors

of 500-hp each operating at a nominal 110-psig pressure. The ventilation system consists of three fans totalling 900,000-cfm capacity. Six pumps in three separate stations make up the dewatering system.

Panel mine has one of the most undulating ore bodies in the region. Its dip averages but 15 or 16 degrees, yet varies from flat (0 degrees) to 50 degrees. A room-and-pillar method is used in the areas where ore structure, thickness and attitude permit trackless or semitrackless operation. In other mine locations, however, the mine is being converted to a system of footwall haulage, the raising of boxholes to the ore and quite standard stope development with jack leg drills and slushing. A crosscut incline between shafts has been extended and conveyor belts added to facilitate development of the middle mine levels. Below the twelfth level, the conveyors are supplanted by a system of vertical, ore- and waste-collection raises.

Ore is hauled, uncrushed, to the surface by a C I-R 120x54-inch 900-hp hoist in Shaft 1, Shaft 2 being the service opening to the mine. Compressed air at 110-psig pressure for mining is furnished by three 500-hp Canadian I-R XVH-2 compressors having a total capacity of 8370 cfm. A total of 750,000-cfm ventilation capacity is installed with an 8,000,000 Btu-per-hour heat input. Two, 250-hp pumps handle mine dewatering tasks.

Stanleigh mine has the deepest orebody of all, the twin shafts serving the workings penetrating to 3800 and 3650 feet and intersecting the ore bed at 3500 feet. The deep workings have an average dip of about 8 degrees, yet conditions warrant the now-developing conversion to a system of track haulage. Drifts are driven through the footwall for the haulage equipment. At approximate intervals of 50 feet, ore passes are driven up to the ore. The previous trackless method using boom jumbos is gradually giving way to a system of mining using jack leg drills. Broken ore is slushed to the ore passes for loading into ore cars in the footwall haulageways. The ore is hauled as-mined to the surface by a double drum 2500-hp hoist handling two 15-ton skips. A 1250-hp hoist is utilized in Shaft 2 to service the workings.

Air for the Stanleigh mine is furnished by three 600-hp XVH-2 units. Of C I-R manufacture, each delivers 3300 cfm at a pressure of 110 psig. Ventilation totals 200,000 cfm and a heating plant of 6,000,000-Btu-per-hour capacity is utilized. Four Ingersoll-Rand 250-hp centrifugal pumps handle dewatering.

*This is the second of a 3-part series about the Algoma uranium district. Milling methods will be the subject of the concluding article.*

*THE BELLOWS—*

# Forerunner Of The Compressor

C. H. Vivian

**T**HROUGHOUT the history of mankind, air under pressure has been a useful servant. At the dawn of civilization, currents of air fanned the charcoal fires of primitive metal-working fur-

naces. Soon afterward they blew man's first musical instruments. At one time, they were used for military purposes.

The leading application through the years has probably been in the field of

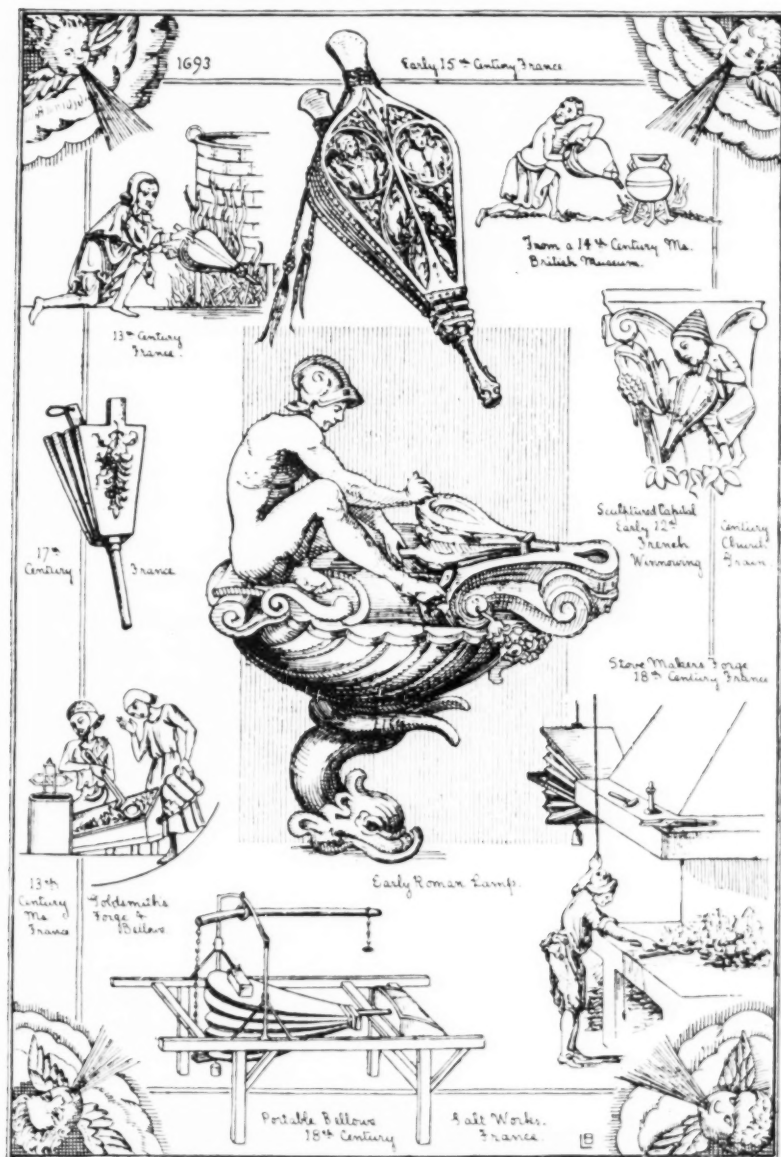
metallurgy. Metals were originally produced from their ores in pits dug in windy hillsides to take advantage of natural draft. The charge of ore and charcoal was placed in the pit bottom and a "blast" was created by boring a narrow wind passage running horizontally through the sloping earth and into the bottom of the furnace.

Next, man used his lungs to blow through a reed or crude clay pipe. Then he fashioned a bag from an animal skin and alternately squeezed and opened it to discharge and take in air. It was then but a short step to the creation of the bellows, the direct lineal antecedent of today's air compressor. Bellows did most of man's blowing until a little more than a century ago, and they still fulfill many needs for low-pressure air. The first bellows were operated by the hands or feet, later ones by animal and water power.

The Greeks, Romans, Africans, Chinese and Indians all made use of the air blast to smelt ores and work metals in remote times. Tubal Cain is mentioned in *Genesis* as an instructor of workers of metals. Sir Flinders Petrie wrote that copper was known and used to make weapons as early as 8000 B. C., although it did not come into general use until much later. Bronze axes are believed to have been made in 3000 B. C., and by 2500 B. C., the metal was being used to produce swords, daggers and other weapons in Egypt, India and Mesopotamia. A variety of refined iron, extracted from ore mined along the shores of the Black Sea, was in general use in Greece from 3000 to 4000 years ago. The air for blowing the furnaces came from hand or foot-operated bellows run by slave labor.

In what is now Ghana, in Africa, are the remains of more than 100 very old iron mines, and it is claimed that the secret of smelting iron ore was first learned there. A thousand miles to the south, in Angola, a mountain of ore provides raw material for an important hoe-making industry, just as it did 3000 or 4000 years ago. The native version of the discovery of the deposit is reported as follows by the African Society:

God placed our ancestors down by  
this mountain of ore. They could not



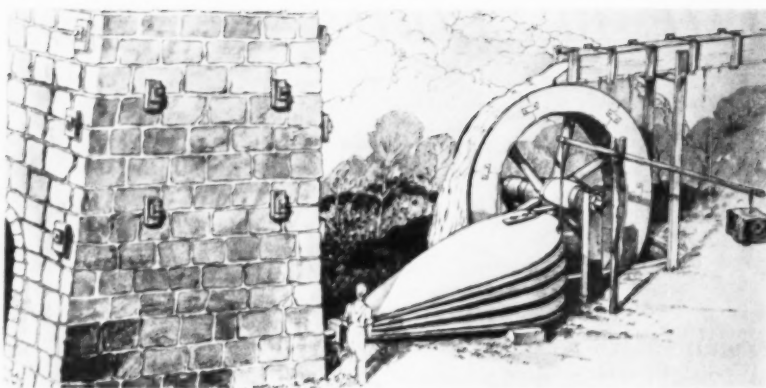


tell what it was, but considered it to be different than the ordinary rocks. Somebody made a bellows of clay, then killed a small deer and tied its skin over the cavities to cause the wind to blow. It would not answer, but broke. Someone else said, "let us make one of wood." So they went into the forest, cut a tree, made a bellows, made charcoal, got some of the stone and put it into the fire and it got soft. Our ancestors before this cultivated with wooden hoes. They tried to make an iron one and succeeded and that is how we began to cultivate with the iron hoe.

The hoes, called "molotes," are still made much as they were originally. The industry is a communal endeavor and the hoes are the principal article of barter with other natives. Now bellows consist of two clay pots about a foot high, their tops covered with loosely stretched pieces of pliable leather. In the center of each cover is a 4-foot upright stick. The sticks are worked up and down alternately, to provide a strong blast. A 2-foot clay pipe extends from the bottom of each pot to the base of the charcoal furnace.

In some parts of Africa, itinerant goldsmiths still carry their kits in a buckskin sack, which becomes a bellows when unpacked.

Because the all-leather bellows soon developed leaks, someone devised the traditional pear-shaped type having



#### FURNACE BELLOWS

Shown is a typical cold blast charcoal furnace sketched from a plan of a nineteenth century installation. A pair of cams on the water wheel worked the counter-weighted bellows. The man is in proportion to the actual size of the plant.

boards at the bottom and top, with flexible leather sides. The earliest known representation of such bellows was found on a wall of the tomb of Rehmara, governor of Thebes during the reign of Thothmes III, about 1500 B. C. The bellows were worked by the feet, and presumably were used for smelting copper for the doors of the Temple of Amen at Karnak. Bellows are also depicted on early Roman lamps.

In the Old Testament, Jeremiah mentions that "the bellows are burned, the lead is consumed of fire." Homer, in

*The Iliad*, wrote of Vulcan, god of metal-working:

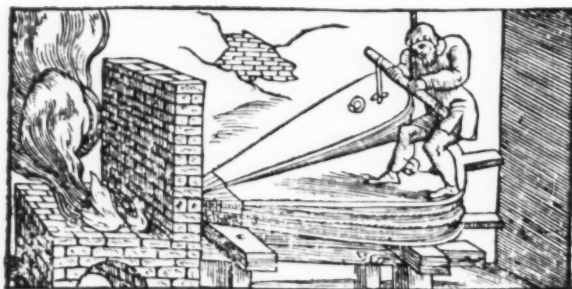
Obscure in smoke his flaming forges round,

While bathed in sweat from fire to fire he flew:

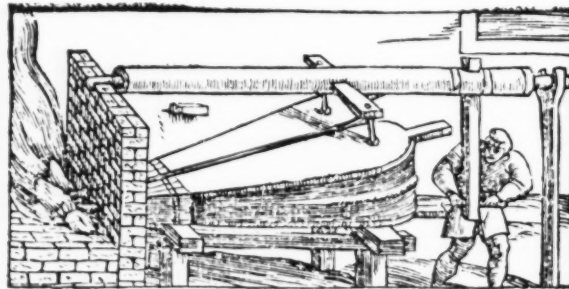
And puffing loud the roaring bellows blew.

By adding a third board to the pear-shaped bellows, an air-storage chamber was provided, thus giving a more continuous blast. Such bellows were in general use in metallurgical works early in the sixteenth century.

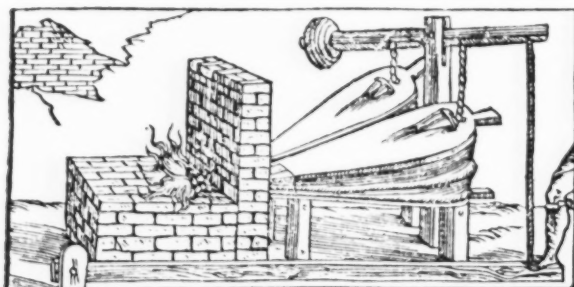
### Bellows From Biringuccio's *Pyrotechnica*



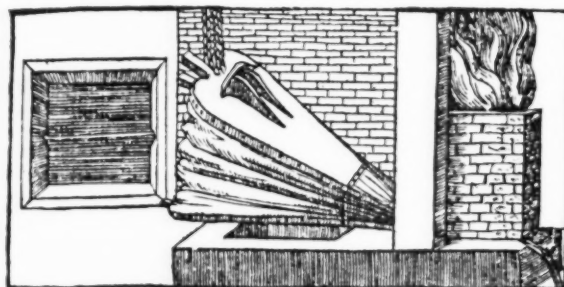
DIRECT OPERATION BY MAN'S WEIGHT



OPERATION BY MEANS OF A ROCKING BAR

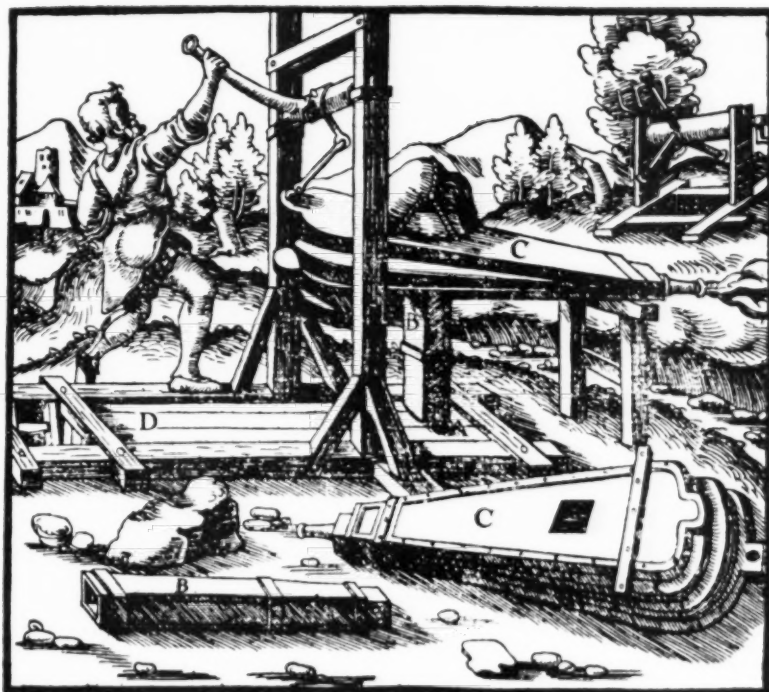


OPERATION BY MAN'S WEIGHT ON TREADLE



EARLY REFRACTORY BLAST FURNACE





#### MINE VENTILATION

In "De Re Metallica," Agricola tells of a method of ventilating mine shafts up to 120 feet in depth with the bellows arrangement shown in this sketch (one of 289 original sixteenth century drawings accompanying the 1556 book). "C" denotes the bellows, both its design and means of operation being fully depicted by a spare lying alongside the shaft as well as the one in place. The square conduit leading into the opening is identified as "B." "A" and "D" are the smaller and larger shaft compartments respectively. Agricola also tells of blowing fresh air into tunnels with bellows of the same type as well as with ones that were foot operated.

Charcoal furnaces with a type of blowing equipment that predates the bellows are still rather common in remote parts of Asia and Africa. They consist of two goatskin bags lying side by side on the ground with their open ends enclosed in the funnel-like mouth of the air delivery pipe. They are worked by a combination of foot and hand power. A native stands with a bare foot on each bag. Underneath each foot is a hole that constitutes a valve. The man shifts his weight alternately from one bag to the other and at the same time raises or lowers the heel to open or close the valve. On the inflation stroke, he pulls upward on a cord to open the bag and fill it with air through the valve.

The furnace of the simple shallow-pit type has changed little through the centuries, but the raw material and the product have. Formerly iron ore was reduced to a ball or *loup* of stiff, plastic, impure metal, which was withdrawn and hammered until most of the cinder was removed. The product was wrought iron.

Today the process is not so long or involved. The native who wants the village blacksmith to make something for him supplies the iron in the form of metal-

instead of ore. (This he picks up wherever he can and hoards against the time it will be needed. He is not averse to taking anything he can loosen from railroad tracks, such as spikes, bolts or rail plates. To reduce such pilferage in the interest of train safety, the railroad builders or maintenance crews leave a few extra pieces of iron lying around and are thus able to keep their tracks together.) The iron is put into the furnace with charcoal and perhaps a little limestone flux and heated until it is soft enough to be worked into whatever shape the customer wants.

Most authorities agree that wrought iron, probably made in primitive equipment of this sort, was in common usage by 1200 B. C. It was being produced in Britain when the Romans arrived, but Eastern ironmakers were apparently more advanced in the art, having already fashioned the most noteworthy monument in iron—the Delhi Pillar. This weighed about 6 tons, or forty times as much as the largest piece then known in Britain. All bulky pieces were, however, merely aggregations of small lumps formed by the direct reduction of ores in small charcoal furnaces.

The extensive use of bellows in metal-

lurgy and mining during the Middle Ages has been described in detail in two notable books—Biringuccio's *Pyrrotechnica*, and Agricola's *De Re Metallica*.

The remarkably pure iron ore found on the island of Elba could, according to Biringuccio, be refined into malleable iron in a forge with an ordinary smelting fire. A mixture of ore and charcoal was placed in front of a tuyere and then "an arrangement of bellows connected with a water wheel, which moves them, is caused to blow. With a fire of only 8 or 10 hours' duration, the ore is smelted and cleansed of the earthiness which it contains; thus the iron remains all pure in a waxlike mass."

The smelting of more refractory ores, however, required blast furnaces, "which can hold great quantities of charcoal. Near these is a large pair of bellows, very close to the wall, like a great pair of wings. These are usually 6 or 8 braccia" in height and they are set in motion by a strong water wheel to which they are connected so that they have a very large extension for inflation. With their powerful blast, which enters the furnace by means of a tube about 2½ braccia from the bottom, the ore is smelted after the furnace has been filled with charcoal."

In his directions for constructing a blast furnace, he mentioned "good bellows that are wide, long and full in their sides and made of cloth, for the better these are the more they quicken the power of the charcoal fire within the blast furnace and the ore is thereby smelted better and in greater quantity because the fire is the prime agent in this operation."

Either four or six furnaces were grouped together, the number depending on the amount of ore to be worked, and the amount of water available for power. The devices for lifting the bellows were arranged so that either all the bellows worked together or just whichever ones that were desired. "Certainly," wrote Biringuccio, "this is a very useful thing as well as an ingenious one, for this wheel is a strong worker that endures much labor and never tires; and it goes fast or slow as you desire. Surely it is impossible to work without it. If you did, you would wear out an infinite number of men." He mentioned that the bellows should always be in pairs so that the blast would be continuous. Copper tubes or tuyeres were specified—either one to serve the pair of bellows or separate ones for each bellows.

As the blast furnace increased in size, bellows kept pace. When they reached a length of 20 feet, it was evident that another means would have to be found for supplying the blast. This need was met by a blowing apparatus invented in

\*The braccia was a unit of measure that varied from 15 to 39 inches.

1550 by Hans Lobsinger, an organ builder in Nuremberg, Germany. It had cylinders that looked so like tubs that they were called that. Such machines were operated by water wheels until steam power became available, when they became known as blowing engines.

The smaller furnaces abroad continued to use bellows for some decades and all of those established in America in colonial times relied on bellows. During the recent restoration of the first American furnace, originally constructed at Saugus Centre, Mass., in 1642, one of the technical problems that had to be solved was to determine the correct design, construction and size of the bellows. The Boston architectural firm of Perry, Shaw and Hepburn Kehoe & Dean, which was in charge of the work, appealed to this magazine for possible assistance, but we were able to contribute little of value beyond loaning our copy of Biringuccio's work. The bellows at Saugus are on the order of 15 feet in length and 6 feet across the head.

The oldest method of ventilating underground mine workings was to constantly shake linen cloths near the working places. Later, bellows were adopted either for forcing fresh air underground or withdrawing vitiated air. In the latter case, the bellows were placed above the shaft. Air was drawn through a conduit from the shaft and discharged to atmosphere through the bellows nozzle. In many cases the bellows were opened by mechanical linkage from a water wheel and closed by the weight of an attached rock. With such equipment, workings could be ventilated to a depth of 125 feet.

Agricola described the body of the bellows as being made by boards joined by hides. Those used with blast furnaces utilized two hides, and it was stated that ox hide was preferable to that of the horse.

Aside from the mining and working of metals, the blowing of organs and related musical instruments provided the greatest application of bellows in the past. The mythical Pipes of Pan, the syrinx, from which the organ was derived, and bagpipes utilize bellows-like devices. Nero, famed as a fiddler, was reportedly fond of the organ also, and this instrument provided music for Roman feasts and the various arena contests. The Romans introduced the organ into the countries they conquered and it gradually came to be manufactured in those places. Around the tenth century, organs reached huge size in England, requiring, in some cases, several men stepping in lively fashion from one to another of the numerous bellows to supply the required volume of air.

Bellows were also utilized by the ancient Romans to dispense asphyxiating fumes into enemy fortifications. For

this purpose, a hole was first drilled through the protective walls with what was one of the first drills of mechanical nature ever invented. It is said to have been devised by Calos, who was later put to death by being thrown from the Acropolis in Athens.

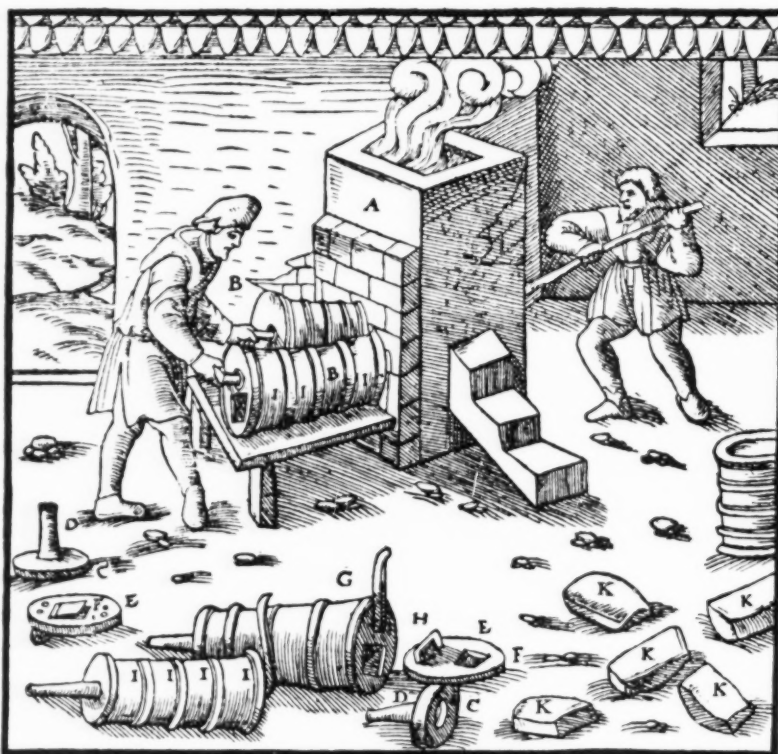
Whereas the original fields of the bellows' service have been largely taken over by other types of equipment, many new uses have appeared and bellows are still rather common. The small hand variety is helpful in encouraging fireplace fires to glow brightly and is often also adapted to spread insecticides and germicides. A less common use is to send out clouds of smoke to aid in the handling of bees. Many of today's bellows are made of rubber or plastic. There are also the metal kinds that absorb expansion, contraction and vibration in pipe lines and also form a useful part of various regulating instruments.

The firm of Absalom Harrop, Ltd., in Sheffield, England, still does a thriving business in bellows, which are ship-

ped to various parts of the world. The company is a consolidation of numerous others, one of which dated its origin to the year 1632.

The familiar pear-shaped types are made for export to Spain and South America. They are also still preferred by some British blacksmiths, who claim that large bellows give a softer blast for welding and heavy work than the more modern and smaller blowers. The double bellows, with a reservoir above the working section, are preferred for this service. Small single bellows are employed in factories to blow dust, lint, etc., from machinery and are found at most fireplaces.

In the archives of the firm are some examples of bellows formerly used. One is a file-forgers' bellows that was made in 1816 and used until 1929. It looks to be still serviceable if it were re-leathered. Another relic is a ship's foghorn from the early nineteenth century that is still capable of producing a mournful sound. It consists of a pear-shaped hand bellows fitted with trumpet and reed.



#### TIN SMELTER

The bellows arrangement shown in this illustration also appeared originally in "De Re Metallica." The smelter was used for refining tin. The Hoover translation describes the bellows as "... made of leather, of which the fore end is a round iron disc and the rear end a disc of wood; in a hole in the former is fixed the nozzle, in the middle of the latter the blow hole. Above this is the handle or haft, which draws open the round bellows and lets in the air, or compresses it and drives the air out. Between the discs are several iron hoops to which the leather is fastened, making such folds as are to be seen in paper lanterns that are folded together." In the diagram, "A" is the furnace; "B," the bellows; "C," the iron disc; "D," the nozzle; "E," the wooden disc; "F," the blow hole; "G," the handle; "H," the haft; "I," the hoops; and "K," masses of tin.

Skilled engineering and carefully matched components go into packaged boiler systems. A recently installed 100,000-pound-per-hour, factory-built unit keynotes the growth of—

## PACKAGED STEAM

Robert James

PUTTING together a steam boiler plant is a much more complex task than would be expected at first glance. Essentially, the plant requires only a pressure vessel and a heat source, plus some means of feeding water and removing the amount of steam required within limits of the system capacity. However, providing for maximum efficiency of the plant, is another story. Control equipment, much of it quite complex, must be added to regulate fuel rates, feedwater input, steam rates and the like. Draft control and air preheat apparatus must be installed to insure efficient combustion of the fuel.

In designing a large plant—the size of those found in central generating stations and larger manufacturing establishments—a great amount of engineering time and effort are expended to balance the various components for their utmost efficiency. One wag has suggested that the weight of the design-calculation paperwork should equal that of the installed foundation. Be that as it may, high engineering and design dollars are well spent because a less-than-1-percent savings in operation can support these costs when apportioned over a many-year period.

Until the 1930's, such benefits were elusive in small systems, because the engineering and design time required to assure most efficient operation did not decrease in proportion to the shrinking of the plant's physical dimensions. The

point of diminishing returns often was reached before the best possible design was obtained.

### A New Concept

In the early 1930's, a concept was born in the industry—packaged boiler systems. Standardization was the key. Because a number of installations were to be put together, engineering and design charges could be distributed over all of them, thus holding the line on costs, but assuring high efficiency. This concept also offered the advantage of a single source of supply, and responsibility. With the assembly of all components into a package, ready for use with a minimum of field erection time, costs were further trimmed. Another advantage, reduced delivery time, is important to new plants or to add to the capacity of established ones.

World War II brought expansion to the industry. The packaged systems were ideal for rapidly built military installations, both of a permanent and temporary type. After the war, the burgeoning industrial growth of the nation provided further impetus to the industry at large, and new upper limits to their size. New materials and design concepts aided in designing boilers of greater capacity that were within shipping clearance limitations. Efficiencies of 82 to 83 percent were attained for the majority of packaged units, and for larger ones with heat recovery equip-

ment, even higher efficiencies were realized. The size of the market made it possible for suppliers of accessories to work closely with the boiler manufacturer and to furnish equipment specially designed to work harmoniously with all other components.

### Numbers And Types

There are, today, a number of manufacturers of packaged boilers and the size of units available runs from the very small to one having a design capacity of 100,000 pounds per hour of steam at 660 psig and 750°F. The 100,000-pound unit is the largest installed to date and is one designed and equipped for full-scale industrial use.

Basically there are two types of packaged installations, just as there are two types of boilers. One is the so-called fire-tube design. Hot combustion gases are passed through a tube or tubes running through a pressure vessel holding water. The entire steam-making process takes place inside the vessel. The size and capacity of such a unit are limited by a simple rule of mechanical design. Shell-thickness requirements are proportional to the internal pressure times the vessel diameter. With higher pressures and larger boilers, the thickness of the shell becomes prohibitive both from a standpoint of cost and weight. Most fire-tube units operate below top limits of about 250-300 psig and 20,000 pounds per hour of steam.



### THROUGH THE WINDOW

The compactness of Combustion's 100,000-pound per-hour steam boiler is dramatically illustrated in this picture as a pair of cranes pick it up and pass it through a window opening into the Scovill Manufacturing Company powerhouse at Waterbury, Conn.



The other type of unit is diametrically opposed to the fire-tube design. It utilizes a combustion chamber through which tubes pass. Water is boiled within the tubes. Much higher pressures can be reached in such units because tube diameters can be kept relatively small, thus reducing the thickness of the walls required to contain the steam. Packaged boilers, that are of the water-tube-design type, are available in capacities to 100,000 pounds per hour and pressures to 900 psig.

### One Installation

The world's largest packaged boiler—the 100,000-pound-per-hour unit—is of the water-tube design and is installed at Scovill Manufacturing Company's Waterbury, Conn. plant. The firm is the oldest brass manufacturer in the U. S. It has been utilizing steam power continuously since 1802, and has consistently displayed a readiness to try the latest advances in steam technology. In 1904, according to Charles K. Stickney, Scovill's chief engineer of power plants, the firm installed its first steam turbine—a 500-kw unit. By 1919 the company's plant was operating at the then high pressure of 250 psig.

At the time the decision to install the unit was made, Scovill had two main boilers. One furnished 250,000 pounds

per hour and the other 150,000 pounds per hour, both at 660 psig and 750°F total temperature. In addition, several 250-psig units were still in service and were used for stand-by duty. Loads were climbing in the plant. The winter load (1955) had reached 400,000 pounds per hour and forecasts indicated that it would soon be 450,000 pounds per hour. Summer loads, similarly, were high—forecasts of those seasonal fluctuations indicated a top of 325,000 pounds per hour. Demand was obviously outstripping supply and because neither boiler could often be spared from service for routine planned maintenance, the solution was more steaming capacity. Scovill engineers determined that it would be most advantageous if that capacity were to be at a pressure level (660 psig) that would enable the use of the extra steam for electric generating as well as for process requirements.

Beyond those requirements, Scovill specified a unit that was adaptable to a wide range of load, relatively quick in response so that it could assume or absorb sudden fluctuations in demand from various manufacturing processes, and compact in physical dimensions so that it could be fitted into the existing boiler house.

The unit chosen was a Combustion Engineering Inc., PCC 120 boiler. (The

PCC stands for Packaged Controlled Circulation). Its principal components are contained in an area approximately 34 feet long and 13 feet wide. The silhouette of the system measures only 13.5 feet in height. A Ljungstrom air preheater and a forced draft fan are supported by existing steel structural members over the boiler. With the exception of these, the boiler installation is complete within the dimensions given. Included is the oil firing equipment, boiler circulating pumps and feedwater regulators.

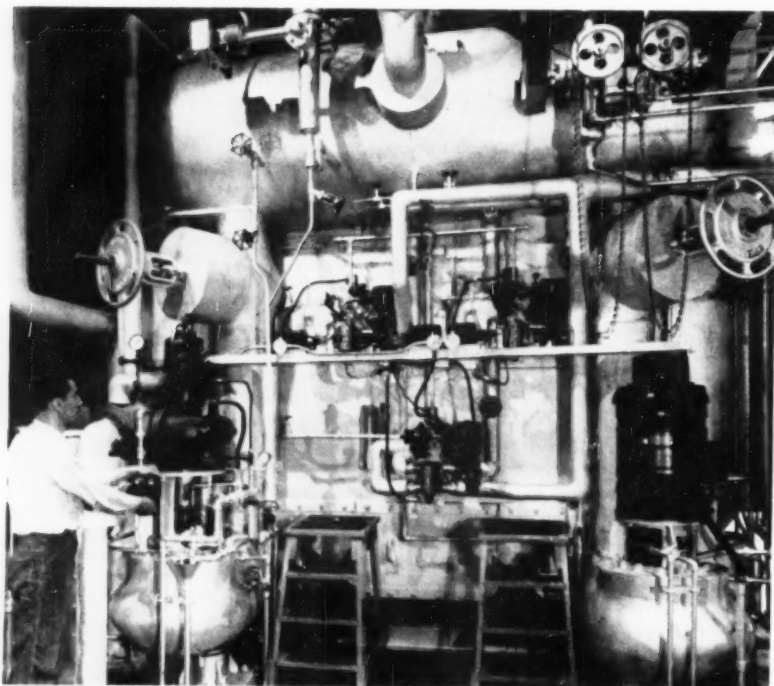
Chief Engineer Stickney, writing in *Combustion* magazine, reports that—"the new boiler can be brought up to load in less than two hours. Similarly it can be taken out for service in relatively short order. This facility for quick startup and shutdown fits in very well with Scovill's need for tight schedules for maintenance and inspection."

### Design Factors

A number of design factors enable the PCC boilers to meet not only diminutive size standards in comparison to assembled-in-place units, but to provide the fast steaming and high response rates typified by the Scovill installation. Small steam separation drums are inherent in the design of packaged systems. Maintaining proper water level in small boilers and drums is difficult as compared to large ones with their much greater water content. The small percentage variations allowable in boilers represent much greater quantities of water in the larger than in the smaller. A Copes Flowmatic regulator is used on the PCC boiler at Scoville. It includes two sensing elements. One responds to changes in water level, and the other, to variations in steam flow. Completely independent of all other control functions, the regulator can hold water level within fine limits. The addition of the second element, which senses changes in steam flow, enables the regulator to "anticipate" sudden fluctuations in feed water requirements.

PCC boilers utilize a system of controlled forced circulation that also aids greatly in meeting wide fluctuations in demand. Water tube boilers can be of two types—forced circulation or thermal circulation. In the latter, the flow of water through the system is powered by the pressure differential existing due to the difference in water density in the downcomers, as compared to that of the steam-water mixture in the risers. Heating surfaces within such boilers must be arranged carefully and tube diameters must be quite large to reduce friction. In certain applications, of course, all these things are permissible and in some cases even desirable. For fast-steaming boilers, however, forced circulation provides many advantages.

Tubes in forced circulation boilers can



FRONT VIEW

This view of the front end of the boiler shows the three burner assemblies firing the unit (center) and the boiler circulating pumps at the bottom. The one on the right is the motor-driven unit; the one on the left, the turbine-driven pump. The units take suction from the drum immediately above them and discharge to a common header crossing the boiler between the pumps. Water then passes through orifices into each of the boiler tubes.

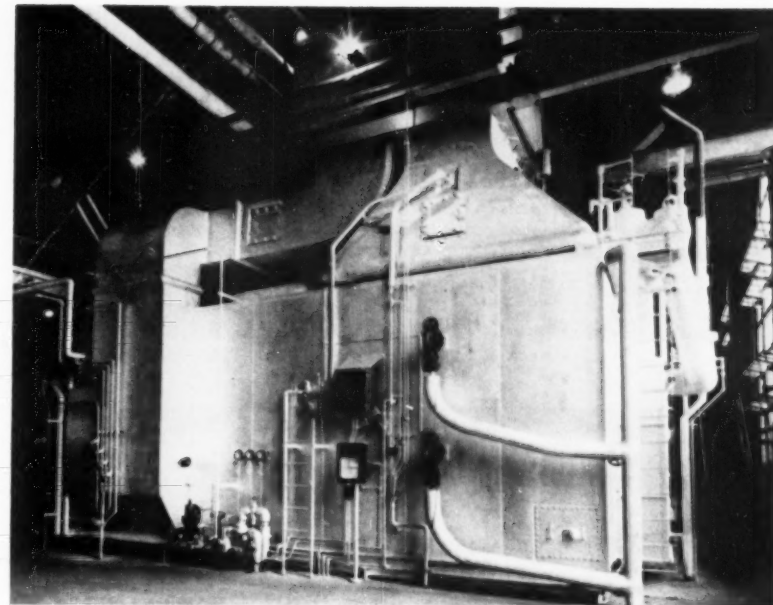


be quite small thus achieving a rapid rate of heat transfer—a desirable end furthered by positive controlled circulation in the tubes. The smaller amount of water contained in the tubes also means fewer Btu's are needed to start steaming, thus aiding fast start-ups and, conversely, quick shutdowns, as well as rapid response to fluctuations. In the design of the unit, arrangement of heating surfaces within the boiler is not subject to the requirements of thermal hydraulics—more tubes can be packed into a smaller volume thus aiding in size reduction.

In the Combustion packaged controlled circulation boiler, steam is generated in the tubes and is carried along with the forced water supply to a drum where the vapor and water are separated. Two pumps take suction from the bottom of the drum, and discharge to a common header from which all tubes are fed. At the entrance to each tube is an orifice that controls the amount of water admitted in accordance with the heat absorption of the tube. Circulating pumps are of benefit in steam separation as well. They develop a high pressure differential through the system and result in a high velocity for the steam-water mixture being discharged through the steam separators in the drum. This results in a more complete separation of vapor from fluid than would be possible if only the head generated by thermal factors were in use.

### Pump Characteristics

The pumps installed on the PCC 120 are Ingersoll-Rand 6 PC units that were specifically designed for that service. The requirements were for a compact,



SIDE VIEW

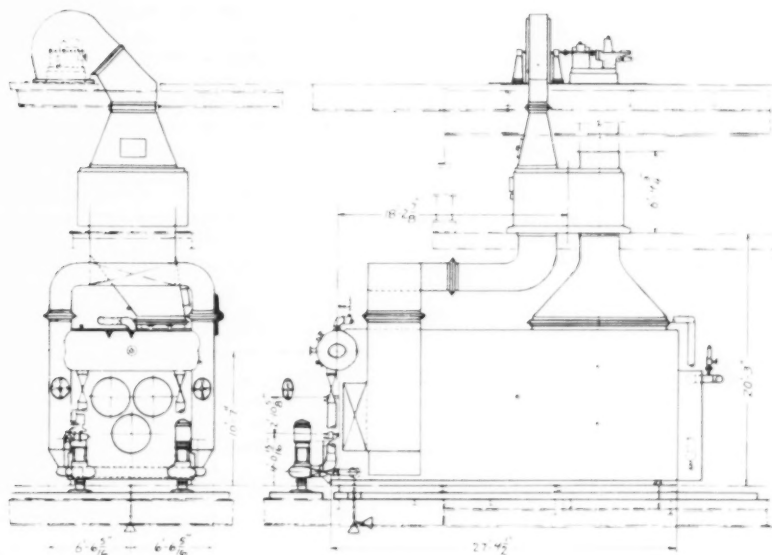
The packaging concept of boiler design makes for desirable savings in field erection time. Virtually the entire installation can be seen in this view. The connections to exterior sources of power, to the stack and to water and service lines are seen to be very few in number. The air feed ductwork is at the right and the connection to the stack, in the center.

vertical pump with a low net positive suction head (NPSH). The pump had to be vertical for support reasons, it being actually supported from the drum through the suction line. It has to be compact to fit within the limited vertical height available, and also so that it could be shipped as part of the package. The pump had to have a low

NPSH because of the very limited head room. Under some operating conditions, only a 7.6-foot NPSH is available. The Size 6 pumps are rated at 770 gpm at 495°F and 105 feet total discharge head. Suction pressure at full load with both pumps operating is 713 psig and discharge pressure under the same conditions is 749 psig. The units are of double-suction, dual-volute vertical construction with soft packing and overhung impellers. The packing is arranged for cold water injection.

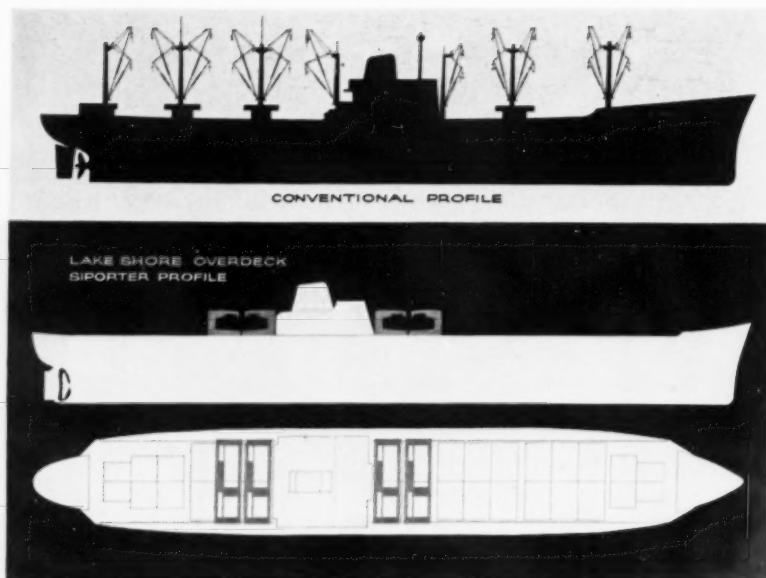
One pump on the Scovill boiler is driven by a General Electric 30-hp. close-coupled, 440-v, 3-phase, 60-cycle motor, and the other, by a Terry steam turbine rated at 35-hp with inlet conditions of 250-psig steam at 550°F and 5-psig backpressure. Although both pumps are normally used at all operating loads, one can sustain the boiler at approximately 80 percent of full load capacity, due to the flat nature of the capacity curve of the machine. Under this abnormal operating condition, either pump is capable of delivering 1280 gpm against a total discharge head of 82 feet.

With the development of packaged steam boilers in the range from 50,000 to 100,000 pounds per hour output at pressures and temperatures suitable for a wide range of power as well as process needs, the era of packaged steam power may well extend indefinitely Man's age of steam.



BOILER DETAILS

This drawing shows the locations and relative sizes of the major portions of the Scovill installation as well as over-all dimensions.



A New Method Of  
Handling Cargo Is—

## Changing The Silhouette At Sea

**E**FFICIENT handling of cargo is a problem that has continually plagued shippers from the day the first cargo ship went into service. The task was first done by hand—and sometimes still is—but through the years, power winches handling material in slings or on pallets have replaced manual methods.

Even though such cargo rigs eliminate considerable manual labor there remains a vast amount of material that must be handled by men, both on the dock and in the ship. Notwithstanding close supervision and good working crews, this is an expensive, time-consuming operation. Costs are further increased because of damaged and lost goods, and pilferage.

A few years ago, it was recognized that something should be done to eliminate much of the multiple handling, which involved original packing of an item in a railroad car or truck, shipment to the pier, unloading, export packing, transfer to shipside, hoisting into the ship in small loads, and stowage.

The idea of packing the material in containers at the shippers' plants was conceived. Containers could be sealed and delivered to the pier by rail or truck and hoisted aboard ship. The theory was sound, and when put into

practice, relatively small, 6x6x6-foot, packages could be handled adequately. With this success, the value of using larger containers became evident. Such methods of packaging and shipping are standard today.

Maritime architects were faced with the problem of providing for proper stowage of the boxes aboard ship. It became immediately evident that each container must be hoisted aboard and lowered directly into the position it would occupy during the voyage; transfer fore, aft and athwartship were not yet practical. Such methods and their difficulties continued in widespread use throughout World War II, even when large orders had to be processed and shipped with minimum delay. Clearly something had to be done to speed the operation.

During the last year of the war, Lake Shore Engineering Company, a 101-year-old, Iron Mountain, Mich., manufacturer of marine equipment, worked with the United States Maritime Commission to find a solution to two of the principal cargo-handling problems. The first was the slow handling rate (an over-all average of 6 tons per hour) for holds located below superstructure areas of passenger and cargo-passenger vessels. These sections were being serviced by elevators,

### THE NEW LOOK

The top view is a profile of a typical cargo vessel with its high, heavy rigs for loading cargo. In the middle is a profile of a vessel equipped with two Overdeck Siporters located fore and aft, facing each other. The bottom view shows the deck with the location of the Siporters and rails (the dark lines on the deck) that carry the units fore and aft to service all holds. Two extendable booms move port or starboard to pick up cargo on the docks.

hand trucks and ramps through side-port openings. The second problem dealt with the application of containers and increased lifting capacities to speed hold loading. An attempt to solve this was underway at the time through the use of bridge cranes that reached beyond decks on outriggers. However the heavy, tall structures proved to be impractical because they caused excessive list and roll during loading and a loss of stability at sea.

Lake Shore proposed to solve the first of these problems by the application of operating booms and trolleys that would operate horizontally. These connected to blind holds by an athwartships passage and trunk. This device, developed for the athwartships passage, became known as a Lake Shore Siporter of the extensible-boom type.

Basically, the Siporter was a pair of long, horizontal booms that could be extended over the dock through a port opening on the shore side. Cargo on pallets was suspended from a pair of small trolleys running inside the booms. These trolleys carried the loads between the dock and the hatch at the center line of the ships.

A further development of the Siporter followed almost immediately when it was realized that this operation could

also be handled by a horizontal traveling crane that required only one operator and no machinery room to house the boom drive, trolley drive and hoist of the first model. The result was known as a gantry-type Siporter. It was built as a self-contained unit that traveled athwartship on deck-mounted rails. Up-rights, at the four corners of this small traveling gantry, supported horizontal booms that could be extended at will ahead of the gantry, through the port opening and thence over the dock. Blocks suspended from the ends of the booms supported the cargo-laden pallets. Loads were taken aboard by moving the entire machine.

Siporters, operating on the same principle but with the gantry and deck rails replaced by ones suspended from the ceiling, and a suspended trolley-type main frame, finally evolved. This type was installed on American Export Lines' *Constitution* and *Independence*, and on Moore-McCormack Lines' *Brazil* and *Argentina* to handle automobiles.

To solve the second problem of cargo in containers placed in open holds, Lake Shore proposed a bridge traveling unit that would move fore and aft on raised rails. A boom was suspended under the bridge that could be projected out over the dock. A load trolley was supported on the boom and arranged to travel in synchronization along the boom so that it would reach a position at the outer end of the boom as the arm approached its full outreach. The machinery, bridge frame and rail support structure all remained stationary and did not induce list. Only the boom and lightweight trolley mechanism, while traveling outboard, added to the list.

By early 1950, as a result of this early development work, the Overdeck Siporter followed naturally. The features of the Siporter were combined with the fore and aft movement required for placing cargo through the freighter hatches. A scale model of a new cargo-handling system has been described as the first step toward completely automated ship loading.

The Overdeck Siporter is ready to go into operation as soon as the ship arrives at the pier—no rigging is required—and is capable of moving a 25-ton, 17x8x8-foot container from dockside to hold within 5 minutes. Based on these figures, 240 tons can be handled in an hour. This compares favorably with a 20-ton-per-hour rate for a normal crew working on one hatch. Adoption of the units by shippers will very likely make it possible for a sea-going freighter to cut unprofitable port time by one-third.

Electric powered, the device consists of a pair of parallel horizontal booms. They can be extended outboard from either side of the vessel and retracted to reach any area of the ship's beam. The unit is designed to move fore and



#### WORKING MODEL

This scale model of the new cargo handling system is described as being the first step toward completely automated ship loading. It would do away with old-type booms on ships, would greatly speed up cargo handling and would bring about a complete new look to cargo vessels. In this demonstration, it can be seen how the device could load 20-ton shipping containers directly from the dockside to the hold. Two parallel horizontal booms are extended outboard from either side of the vessel and retracted to reach any area of the ship's beam. The whole unit moves fore and aft on fixed rails to reach any deck hatch, without respect to the working area on the dock.

aft on fixed rails to reach any deck hatch. Thus, even limited dock area presents little restriction to rapid material handling.

A C-frame construction was used to provide a completely enclosed machinery space and give the operator optimum visibility. By using this shape, large bulky objects such as long tanks or pipes can be hoisted easily, and loads twice as great as can be handled by one unit can be lifted by using two over-deck rigs facing each other and working in tandem.

Operation is controlled from either a central console aboard ship or by a remote control unit on the dock. Studies are underway, however, to add completely automated controls. In such a system, punch cards or identifying marks on the containers would actuate electronic equipment to guide the Overdeck Siporter to the proper locations in the various holds.

Cost of each unit is expected to be approximately \$200,000, with variations according to the capacity and control systems required. Several major shipping companies in the United States are conducting engineering and economic studies of the unit for installation on freighters now on the drawing boards or under construction. Preliminary stud-

ies indicate operators are considering use of two to four units per ship.

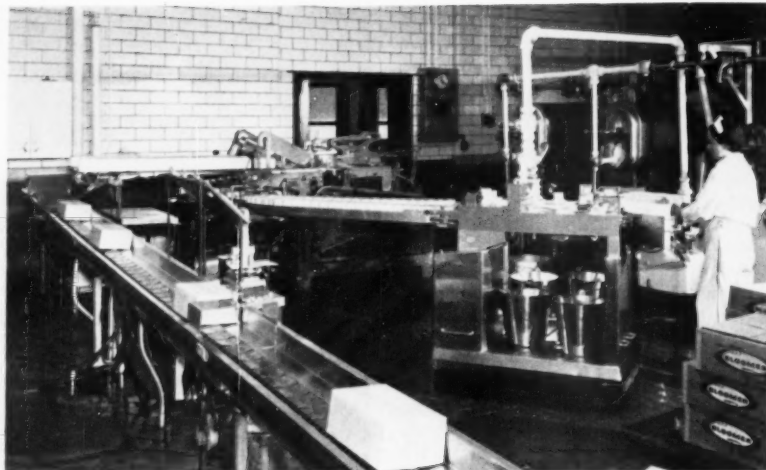
The evolution of the Overdeck Siporter has been hastened by the growing emphasis on "cartonization." A committee of The American Standards Association currently is establishing uniform sizes for huge shipping containers. These will be interchangeable between highway trailers and railroad cars and ships. Adoption of such standards will make it possible to extend proved benefits of truck-rail piggy-backing to all forms of surface transportation.

According to Lake Shore officials and a number of other marine experts, mechanized cargo handling is becoming increasingly essential to the United States in her effort to remain competitive with foreign lines without prohibitively high Government subsidies. Higher labor costs on the United States' ships require that man power be used with maximum efficiency.

Both Siporters and container handling methods already in use by the United States ship owners have pointed the way. The next step is to improve shipboard facilities for handling containers. The ultimate system of efficient handling is complete automation of Overdeck Siporter units, based on the extendable-boom principle.

#### PACKAGING

Here Hood's Portland, Me., dairy puts up ice cream in a highly automated process that includes conveyors and automatic filling and bundling machines. Each bundle is imprinted with the name of the particular flavor that it contains.



**Compressed Air Finds  
A New Use In—**

## *Ice Cream Manufacture*

**C**HILDREN, last year, consumed an average of 4 gallons of ice cream each. So did their elders. A total sales figure of more than 600 million gallons of the chilly dessert will be reached in 1959. Besides the fact that such sales will keep from 1,500,000 to 2,000,000 cows busy, the ice cream market is truly big business today. As such, its processes receive cost-cutting and control attention as well as a great deal of research aimed at improving product quality and purity.

A large New England ice cream manufacturer, H. P. Hood & Sons, Boston, Mass., has found that oil-free compressed air can be of great aid, both in cost control and in improving quality and purity of its products. At Hood's Portland, Me., plant, ice cream is mixed in batches of 300 gallons. Oil-free compressed air is used to agitate the mix, which contains sugars and flavorings as well as butterfats, to keep it from segregating. Raw milk and concentrated raw milk are also stirred with oil-free compressed air to keep the butterfats from rising to the surface. In addition, the agitation prevents the formation of an ice cake on the cold plates in the holding tanks.

At the Portland plant, raw products are stored in three tanks. One is a 4000-gallon Cherry Burrell unit used for milk, and two are 2000-gallon Pfaudler receptacles for concentrated raw milk. The mix itself is held in five tanks having a total capacity of 9000 gallons. Three 1000-gallon, 90-degree cold-wall tanks of Pfaudler manufacture, one 4000-gallon Cherry Burrell 180-degree tank; and one 2000-gallon, 180-degree Chicago stainless tank make up the mix holding battery.

A 90-degree cold wall tank is one

**Joseph Flamand**

having 90 degrees of its inner diameter covered with chilling plates. The plates are usually located in one of the lower quadrants and through them is circulated a refrigerant. Similarly, a 180-degree tank is one having its lower half covered with cold plates.

All of the tanks are fitted with stainless steel pipes entering through an opening at the top and extending to the bottom. A horizontal segment runs the length of the tank and is suspended a short distance above it. This pipe is drilled with  $\frac{3}{16}$ -inch holes on 9-inch centers to pass oil-free compressed air into the tanks. The 1000-gallon units utilize 1-inch tubing; the other sizes,  $1\frac{1}{2}$ -inch pipe. The discharge orifices are positioned so that air is directed to the cold plates at an angle of approximately 45 to 60 degrees from the vertical. Aiming them thus causes the mix or milk to roll past the plates with a relatively high velocity, thereby preventing ice build-up on the cold plates.

Compressed air is furnished at pressures of 5 to 7.5 psig by an air plant consisting of two Ingersoll-Rand NX7-NL compressors. One of the units is installed on a stand-by basis. The single-cylinder units are driven by  $\frac{3}{4}$ -hp motors and have a piston displacement of 10.8 cfm at 760 rpm. They have non-lubricated cylinders, thus avoiding any possibility of contaminating the product with oil carry over. A Dollinger in-line filter (Size AAPH) is installed as an added safeguard and is checked and cleaned four times annually.

The ice cream mix itself consists of about 11- to 18-percent butterfat, has an average weight of 8.5 to 9.5 pounds

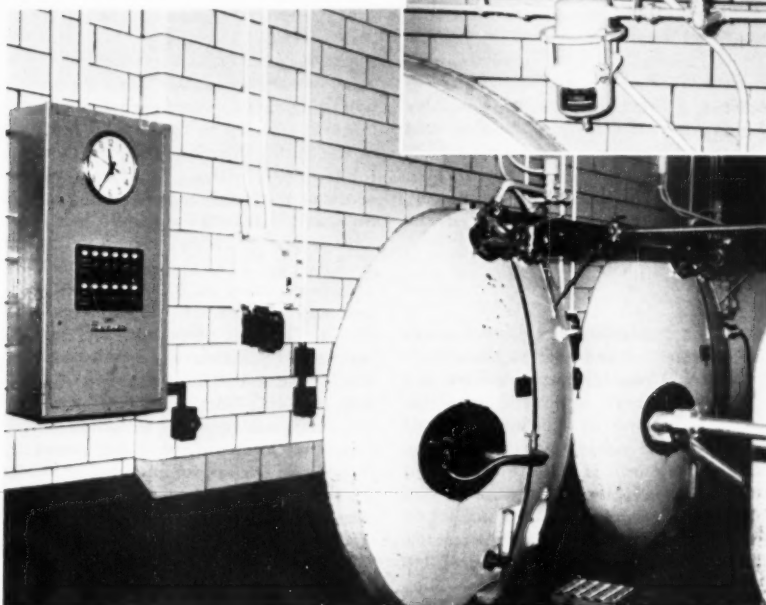
per gallon and is required to be held at a temperature of 40°F, plus or minus 2°. The raw products consist of 3.5- to 25-percent butterfat and have a similar per gallon weight. To effectively keep both types of fluids mixed requires an agitation period of approximately 5 minutes per hour. Agitation is effected on that schedule throughout the holding period, which may vary from 1 to 24 hours. A Simplex timing panel is utilized to control the air agitation cycle by starting and stopping one of the compressors as required. It then automatically opens a solenoid-operated valve in one of the air lines leading to a tank. Only the valve to one tank is open in any 5-minute period. With eight tanks, then, a minimum 40 minutes of operation each hour is required of the compressor. The compressor can handle up to four more tanks on the agitation cycle, and the timing control board has room for a like number of additional units, should more tanks be added in the future.

One of the most outstanding advantages to Hood of the air agitation method for its ice cream mix is that one  $\frac{3}{4}$ -hp compressor normally handles the entire agitation load for the eight tanks. Independent mechanical agitators for each tank are thereby eliminated. In addition, contamination from leakage into the tank through the mechanical seals used with conventional agitators is eliminated, as is the mess caused by mix leaking out of the tanks via the same route. The pipes of the air agitation system are more easily cleaned and sterilized than are the complex parts of mechanical systems. Further, the air method uses less valuable space in the dairy products plant. A great deal of maintenance is normally required to



keep the gear trains of the mechanical systems in good working order, whereas the compressors have required no maintenance in the past 2 years.

Air agitation is equally as fast as the mechanical method, according to Hood dairymen, and the end result is about the same. The choice is a question of cost and reliability. Beyond the advantages of oil-free compressed air in product purity, its lower initial, operating and maintenance costs are most desirable.



#### AIR SYSTEM

The two Ingersoll-Rand NX7-NL compressors above furnish air for agitating ice cream mix and raw materials in holding tanks, the ends of two of which are shown, left. The control box timing device shown in the same picture opens solenoid-operated valves in the air lines leading to the tanks. Each tankful is agitated for 5 minutes of every hour. The panel now regulates agitation in eight tanks. Four more tanks can be added to the present system if required.

### Increased Output Of Woodworking Lathes Results From—

## Pneumatic Components

**A**UTOMATIC shaping lathes used in various woodworking plants, and particularly throughout the furniture manufacturing industry, operate on the basis of simultaneously turning any portion of the length of a piece of work. This is done by using a gang of special cutterheads on a staunch arbor shaft that extends the full length of the machine. Incorporated into shear-cutting knives mounted on the cutterheads is the particular profile to be turned. This gang of cutterheads revolves at high speed.

A swinging carriage is also utilized,

on which is mounted the headstock and tailstock. By swinging the carriage, a turning blank, mounted between centers, can be advanced toward the fast-revolving cutterheads at a judicious rate. As the turning blank approaches the cutterheads, it is slowly revolved on centers. A stop is arranged that permits the swinging carriage to advance only to a particular point. By this means, turnings can be made to predetermined diameters. The production rate is high, and all turnings in a given lot, or from a given setup, are made precisely the same.

Recently, such units have been further refined through the utilization of air power to automatically operate the motions of the tailstock, carriage and steady rests. Moreover, these machines are hopper fed. They will accept turning blanks from  $\frac{3}{4}$  inch to 4 inches square. Length may vary to 30 inches or to 42 inches, depending on the type of machine being used.

Because the air-operated tailstock advances automatically in proper timing with the hopper feed rate of blanks, and the air-operated feed of the carriage toward the fast revolving cutterheads is automatically held at a rate commensurate with best results in turning, highly satisfactory work is obtained at a rate far greater than was previously possible.

Steady rests prevent longitudinal vibration. Earlier models' rests were cam-operated; on the hopper-feed machines, they are pneumatic.

In one case the new machine turns 2x12-inch stock at the rate of seven pieces a minute, whereas on manually operated lathes, the average is two pieces per minute.



# This And That

## U.S., Canada May Build New Bridge

Preliminary plans and cost estimates for a 12,000-foot-long bridge connecting the United States and Canada at Sault Ste. Marie are being studied by the International Bridge Authority and the highway departments of Michigan and Ontario. The structure and its approaches would provide two 14-foot traffic lanes and 2-foot emergency walkways on both sides of the highway. Its main features would vault existing American and Canadian ship canals, and there would be lesser spans over a U. S. power canal and the St. Mary's River rapids. Included in the over-all passage would be five main spans—two American and three Canadian. The approach on the U. S. side, which calls for an American immigration plaza, would be 4145 feet long. The opposite approach would encompass a Canadian plaza and would be 3045 feet long. According to the proposal, 67 piers are needed to cross the St. Mary's River, where the waters have a maximum depth of 20 feet. Eighteen months are included in the construction schedule.

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## Carrying Ice To Africa

A 3-ton piece of ice was recently transported from the Svartissen Glacier in the Arctic, near Norway, to Lambarene, French Equatorial Africa. The journey took 3 weeks and was backed by glass wool manufacturers in eight European countries. The idea for the trip developed with Radio Luxembourg, which originally offered to pay a driver a substantial sum of money for every pound of ice left at the end of the trip. It later retracted its offer when it was pointed out by the glass wool industrialists that ice packed in their insulating material would not melt appreciably and would, therefore, ruin the radio company. The ice was shipped by truck that also carried about half a ton of medical supplies to the jungle hospital of Dr. Albert Schweitzer at Lambarene, a gift of the medicine manufacturers of Scandinavia. The trip was made by road from Norway to Marseilles, France, where the truck was shipped to Algiers by sea. In Africa,

it continued through the Sahara and equatorial jungle to its destination. The driving team consisted of a Swede, with about a quarter-century of driving experience; a Frenchman, with a specialty of driving in deserts and jungles; and a Norwegian engineer from a glass wool mill in Oslo, Norway. A photographer and a repairman also made the journey, but in a small bus that followed the truck.

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## Wishing Makes It So

A great deal has been said for and against the principles of parapsychology, and there is no end in sight. One of the more recent papers on the subject was written by Swedish engineer Haakon Forwald, for which Duke University awarded him \$1000. *Experimental Confirmation Of The Psycho-Kinetic Effect*, as the treatise is called, details the results of more than 100,000 experiments with six dice. They were mechanically ejected onto a horizontal surface. By merely wishing the dice to fall to the right or left on the surface, Forwald found that they generally fell towards the side he desired. Their average difference was about 2 inches in his favor. The influence was the stronger the more heavily the dice were covered with metal, which makes the scientist feel that atom nuclei play an important role in this context. This Fall, the experiments will be repeated at the University of Pittsburgh, and will be filmed in slow motion.

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## The Water Needs Of California

The future growth of Southern California depends on the increased supply of imported water, according to Harvey O. Banks, Director of California's Department of Water Resources. The phenomenal growth of population and industry experienced in recent years may be expected to continue, but only if provision is made for an adequate water supply. By 1970, only 11 years away, the water needs will have fully utilized the entire claimed right of the Metropolitan Water District of Southern Cali-

fornia to Colorado River water. Although an additional annual supply of 1,800,000 acre-feet of water is proposed for delivery to the area under what is called the Feather River Project, even the water right filings of that project would be fully utilized about 20 years after its first delivery of the vital fluid. By 1980, it is estimated that about 17 million of California's projected 28 million persons will live in the nine southern counties, doubling the present population there. In 2020, at which time Banks predicts the area to be fully developed, the population will have tripled to about 28.5 million. Generally, there will be a decline of irrigated agricultural lands as urban areas expand. Such expansion will bring about virtual exclusion of agricultural activity in the coastal portions of the State. Also by 1980, the demand for surplus Northern California water, south of the Tehachapi Mountains, will be nearly 1,000,000 acre-feet per year. This requirement will rise to 1,750,000 acre-feet by 1990 and about 3,500,000 million acre-feet by 2020. For the present service area of the Metropolitan Water District, demands for surplus Northern California water will be about 600,000 acre-feet in 1980, about 1,000,000 in 1990, and 2,000,000 per year by 2020. When the Colorado River Aqueduct is operating at full capacity, it will divert approximately 1,212,000 acre-feet of water to the Water District's area.

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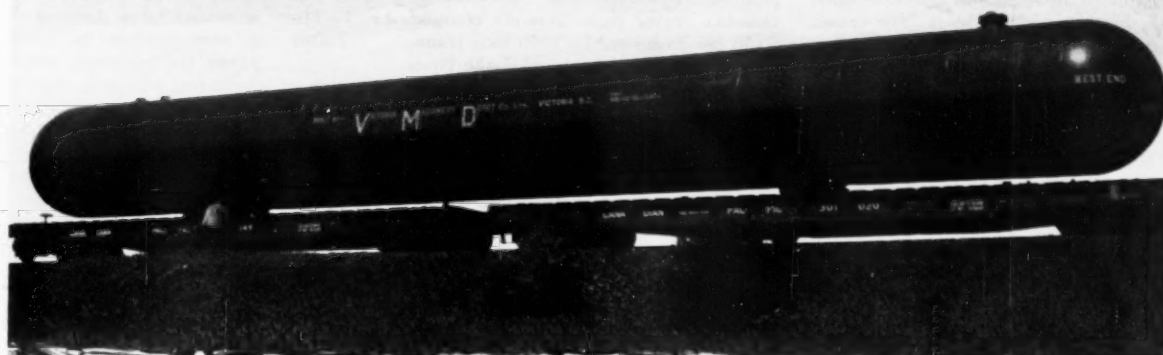
## Deer Saved By Sub

Munching dried clover in temporary quarters that were the laundry facilities onboard the old pocket battleship *Gustav V*, a lonely fawn is recuperating from a strange rescue. A Swedish submarine found it struggling for its life in the icy channel leading to the naval base in the Stockholm archipelago. The vessel, that was on its way to maneuvers, stopped and set out two men in a dinghy. They brought the animal onboard and returned to base with their "shipwrecked" cargo where the deer received first aid. Telephoned advice as to its care was supplied by Skansen, a combined zoo and open-air museum in Stockholm. If not strictly in keeping with military tactics, at least it does confirm our faith in humanity.

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## Handyman Satellite Proposed

A proposed space outpost, to relay radio and television waves around the world, help mariners chart their courses and perform other odd jobs, was described at the recent Aviation Conference of The American Society of Mechanical Engineers.



PHOTO, LIQUID AIR REVIEW

## OVER THE ROCKIES

Making its way over the Canadian Rockies to Breton, Alberta, this Gargantuan pressure vessel not only represents answers to special transportation problems, but sets the record for being the largest pressure vessel ever built in Canada. Weighing 68 tons, this 70,000-gallon steel propane tank is 106 feet long and has a diameter of 11 feet. It is the first of eighteen units being built by Victoria Machinery Depot for the tank

farms of Goliad Gas & Oil Company at Breton, 45 miles southwest of Edmonton, Alta. Eleven of the high-performance pressure vessels are for propane and have been designed for a 225-psig working pressure. The remaining seven of this \$500,000 order are for butane and will have a working pressure of 180 psig each. As they are completed, they are placed on two large railway cars, as illustrated, ready for shipment.

The satellite would be far brighter than all but two stars and four planets, and would be hurtled 1000 miles in space. It would be a plastic sphere covered with a thin film of vapor-deposited aluminum to make it visible on earth, provide a good reflecting surface and protect it from long-term exposure to the sun. Enroute, it would be collapsed. When it reaches its proper height, a 1-pound container of gas will inflate the folded plastic sphere for its orbital journey. Inflated, the prototype will be 100 feet wide and very lightweight—a total weight of about 100 pounds. The type of plastic specified must be able to stand such extremes of temperature as direct exposure to hot rays of the sun or the cold of complete shadow.

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**Colorado Geological Symposium** "Nuclear Blasts In Mining," a technique that has recently received much discussion, was one of four themes at the Third Symposium On Rock Mechanics. The meeting was held in April at the Colorado School of Mines, Golden, Colo., and was sponsored jointly by the Department of Mining Engineering at the Colorado School of Mines, the University of Minnesota and the Pennsylvania State University. Other themes of the 3-day session were: "Factors Common To Communion, Underground Failures, And Failures Resulting From Explosions"; and "Seismology And Explosions." A highlight was a field trip through the Schwartzwalder Uranium Mine a few miles from Golden. The saga of Fred Schwartzwalder, the janitor-turned-pro prospector who in 1950 dis-

covered high-grade uranium ore on the east slope of the Rockies, was told in the February 1959 issue of COMPRESSED AIR MAGAZINE.

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### Factory-Built Highways

Word has come from Stuttgart, Germany, that the head of that city's road construction department, Otto Winternitz, has developed a means of saving considerable time in the construction of roads. While the old highway surface is being removed and leveled and a bitumen-gravel sub-surface bed is being laid, 8-inch-thick concrete surfacing blocks are being cast at a factory. The dried blocks are then taken to the construction site and are fitted over the roadbed. They are next covered with asphalt, and are ready for traffic without waiting for the concrete to dry, thus substantially reducing traffic delays and lengthy detours. The system could be especially useful in countries where heavy-duty road-building machinery is scarce or unavailable, and in the United States for building rural roads.

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### Buck Rogers Rodent

A 5-pound capsule for outer space seems insignificant compared with the tonnages of those already orbiting the earth and sun. Nevertheless, that is the weight of a capsule that is to carry a mouse into orbit. Although tiny, the Garrett Corporation space vehicle is air conditioned and pressurized to create an artificial atmosphere for the rodent, as it sails

through outer reaches where the air is colder than that at the North Pole and too thin to sustain life. Using its experience in air conditioning and pressurizing airplanes and space craft, the AiResearch Manufacturing Division of the company has provided the pesky traveler with an environment that will be as pleasant as if he were scampering around Mexico City at the refreshing elevation of 8000 feet above sea level. The temperature control is maintained by a thermostatic device that will sense the temperature level within the container. If needed, cooling will be accomplished by allowing water in a water boiler to vaporize, absorbing the excess heat in the oxygen. The mouse will have a 30-day supply of pure oxygen stored under pressure in a second container and metered into the capsule through a regulator. To recirculate the oxygen, a tiny fan draws the oxygen out of the capsule, through a carbon monoxide remover and a water separator. It is then fed back into the capsule. The space vehicle was designed in anticipation of future missile industry requirements. It is hoped that what is good enough for the mouse will be good enough to serve as a basis for passenger-laden spaceships.

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### Cost Of Seaway Travel

How much does it cost to travel through the St. Lawrence Seaway? By agreement between Canada and the United States, the tariffs were set on the first of April. They are based on an assessment of a charge per ton of cargo actually carried, together with a charge per gross regis-

tered ton of the vessel. They are applicable to all ships and boats, whether they are laden or in ballast. For vessels traveling the entire passage, that is, from Montreal, Que., to Lake Erie, the assessment is set at \$0.06 per gross registered ton, plus \$0.42 per ton of bulk cargo, and \$0.95 per ton of general cargo. It is 2 cents cheaper (per gross registered ton) to travel only as far as Lake Ontario, and the cargo charges are reduced proportionately. If only part of the distance between Lake Ontario and Montreal is traveled, the charge is based on the number of locks used. (There are seven in this section.) In the Welland Canal, the construction of which was discussed in this magazine's November 1957 issue, the toll is applicable regard-

less of the number of locks used, and is paid in Canadian funds. Commercial vessels carrying passengers are charged \$0.50 per passenger for each lock transited between Montreal and Lake Erie, in addition to the vessel and cargo charge. Pleasure vessels will be assessed the same, with the exception that there will be a minimum charge for pleasure craft of \$2 per lock transited. (The minimum charge for other vessels will be \$4 per lock.) With the exception of the Welland Canal, all trips will be invoiced to show two amounts paid—Canadian and U. S. funds. The former has been set initially at 71 percent, representing the proportion applicable to the St. Lawrence Development Corporation.

**Oil Goes To The Tailor** Using a mass spectrometer, Gulf Oil Corporation scientists have discovered a new method to learn about the molecular composition of lubricating oils with regard to performance. This will permit specific oils to be tailored to particular jobs; molecules will be arranged as needed. Such qualities as viscosity, pour point and resistance to oxidation are determined by molecular composition. A more exacting method for suiting an oil to its task has been needed because of the severe demands on lubricants made by today's high pressures, heats to 600°F and close tolerances in rockets, high-performance aircraft and new industrial processes.

## Big Truck With Big Problems

**F**OR MANY years, Hidroelectrica Espanola, one of Spain's largest privately owned electric utilities, has been taking steps to solve the problem of generating sufficient energy to meet the growing demands of irrigation and industry basic to the development of the Madrid and the southeast regions of the country. This 38,600-square-mile area, with a population of nearly 7,000,000 has been supplied chiefly with hydroelectric power. Recurrent droughts, however, particularly in the southeast region, have resulted in periodic restrictions on power, seriously hampering the economy of the area. The power company is attempting to relieve this situation by building thermal power plants, such as the new Escombreras facility.

To do the job, 150-ton transformers must be hauled to the plant site. This was a considerable problem until Trailmobile, Inc., devised the trailer truck illustrated below. The truck is constructed entirely of steel and has a cradle frame. It can easily handle the 150-ton transformers; and with special bolsters and heavier, longer rails, will take loads to 300 tons. Thirty-two tires are required to support the vehicle.

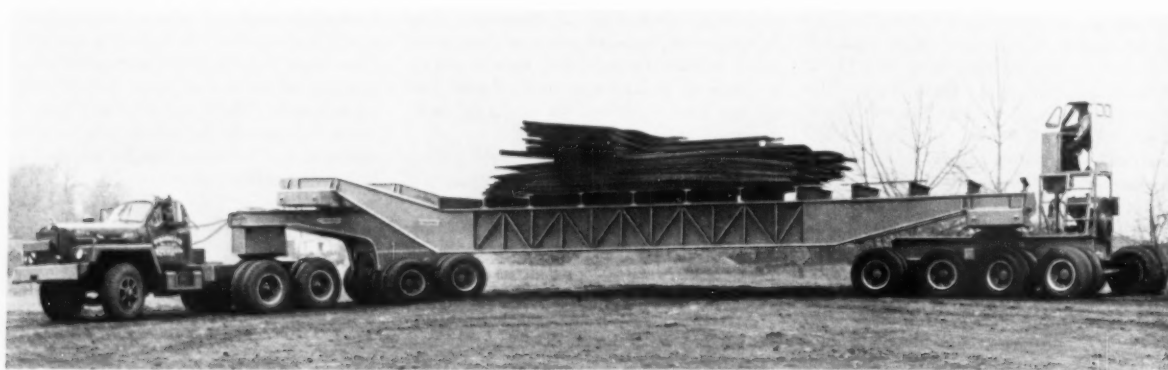
What does such a truck cost? Complete with auxiliary equipment and spare parts, the price tag reads \$50,000.

Two major transportation problems resulted from its design: one, its shipment from the United States to Spain; and the other, its traveling over the curving roads of the Levant region.

The latter was solved by installing a 2-way telephone system between the rear seat and the front tractor cab. Each section has an individual power unit driving hydraulic steering gear. The men in the units are 74½ feet apart, but operate as a team in much the same way as do fire companies' hook-and-ladder drivers.

The problem of getting the giant overseas was solved jointly by Nervion Steamship Company and Trailmobile, Inc. Neither Mobile, Ala., nor Cartagena, Spain, are regular ports of call for the S. S. *Mar Egeo*, the vessel that was to take the load. However, because the trailer was essential to the development program and because the Levant region is important to Spain's power program, the *Mar Egeo* made both off-route calls.

Cost was an essential factor. If Trailmobile shipped the truck as a single unit, the charge would have been about \$27,000. The company dismantled it, however, and thereby reduced the shipping expense by about 75 percent. The 22 separate pieces were reassembled in Spain.



### TELEPHONIC COMMUNICATION NEEDED

Stretched to its full 66-foot length, this trailer, built for a Spanish utility company, caused many problems. For example, telephone communication was necessary between

the driver in the front cab and the one in the rear. Such coordination was of special importance because of the twisting roads over which the vehicle must pass its heavy cargos.



# EDITORIAL

## The Toolbox



OME WEEKS ago, the American Society of Tool Engineers gathered in Milwaukee, Wis., for its twenty-seventh annual meeting. It prompted, in our offices, a desire to look in the world's tool chest to see what it contained. It showed us the

past; it revealed the value of air-powered tools; and it indicated the limitless future.

Historians believe the first mechanical tool was developed about 3000 B.C. A flint, fastened to a stick, became man's earliest power drill when a bow string was looped around it to impart rotary motion.

Archaeologists credit the Sumerians, the first great builders, with some of our more significant inventions. Early Egyptians were the next major contributors to the toolbox with their development of new instruments and tools, including saws. They are noted, too, for what might be called the first production line when they utilized thousands of slaves, toiling side-by-side, welding wedges, chisels and hammers to construct the geometric monuments that still stand as testimony of what is referred to as the second greatest building civilization in the history of the world. Greece must be mentioned for its refinement of gears and wheels. Today, these basic mechanisms have vital roles in tools and their manufacturer.

Cutting tools, of course, become dull with use. Carborundum from Phoenicia had long been utilized as an abrasive. Talcs, sandstones and diamonds soon appeared as sharpeners. Later, siliceous rocks were used; and power grinders and sharpeners gradually filled the tool chest.

In the 1770's, England contributed significantly to the growing list of labor-aiding tools with the first auger bit; and 30 years later, America added the screw tip for centering wood-working augers. From the early days of the American industrial revolution, new tools, *per se*, were rare; improvements of those in the established line were common.

The pattern of tool development had been set. Basic forms were established and have remained. "New" tools are but refinements to do jobs quicker, easier and more efficiently.

**M**ETHODS of furnishing improved power for tools became important. Compressed air was found to be exceptionally advantageous for reasons that are still valid. Today, air power is an essential component of the well-stocked world toolbox.

Percussion tools, such as chippers, riveters, tampers and diggers, have been, and still are in some cases, powered with steam or electricity. Rigorous impacting and ponderous equipment proved them unsatisfactory. For these tools, air power was found to be especially suitable: expanding air results in positive, high-velocity impacts.

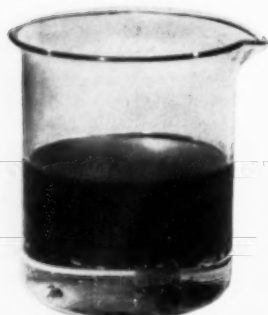
Drills, screw drivers, grinders, motors, hoists and such rotary tools utilize air motors that are, horsepower for horsepower, smaller and lighter in weight than their electric counterparts. When they stall from overloading, they have the further advantage of doing so harmlessly. Like the percussion tools, these pneumatic units are easily moved to job sites and are quickly operative. Areas that were once thought to be inaccessible or hazardous are now valuable production spaces because of the flexibility and safety of air power. It did not take long for air to gain the superior position it now holds.

Such advantages of compressed air make it a labor-saving medium for the men in the shop. They like pneumatic tools for their operating ease. Management, in ever-increasing numbers, is discovering related values. When a long, hard look at costs is required to maintain position in the competitive market, the advantages of compressed air provide substantial dollar savings. When wages, operating time, required facilities and the like are compared, saving with air power is not theory, but reality.

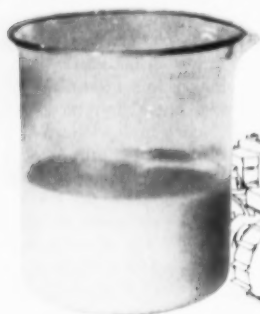
**P**RESENT development merely indicates the rich future of pneumatic tools and compressed air power. Early hand-operated tools of Mediterranean empires built the vehicles of transportation. These crude, but basic, tools gave way, in later civilizations, to single, power units. In our day, many single units have yielded to multiple pneumatic tools, as illustrated most elegantly in the automotive production lines. Our children's eras will firmly establish compressed air in the construction of the exploration vehicles to reach into the vast universe.

As we close the toolbox, we cannot help but think how right was W. L. Saunders, our first editor, when he introduced COMPRESSED AIR MAGAZINE, 63 years ago, by saying, "Air power has been the means by which continents have been discovered . . . It has been the means by which the world has been conquered . . . It is the first cause leading to the wealth of nations." He might have added that it will be a major force as man populates what was once the realm of dreamers and astronomers.

## WHAT YOU SHOULD KNOW ABOUT AIR TOOL UPKEEP



**Ordinary oil  
separates from water**



**NON-FLUID OIL**  
TRADE MARK REGISTERED

**is compatible with water**

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NR Grades work on the logical principle, "if you can't lick it join it." Our specially designed and engineered grades for pneumatic service form a permanent emulsion with this airborne moisture, thus eliminating the normally accepted sticking, gumming and rusting. That's why pneumatic tool manufacturers use and recommend the NR Grades of NON-FLUID OIL for their tools.

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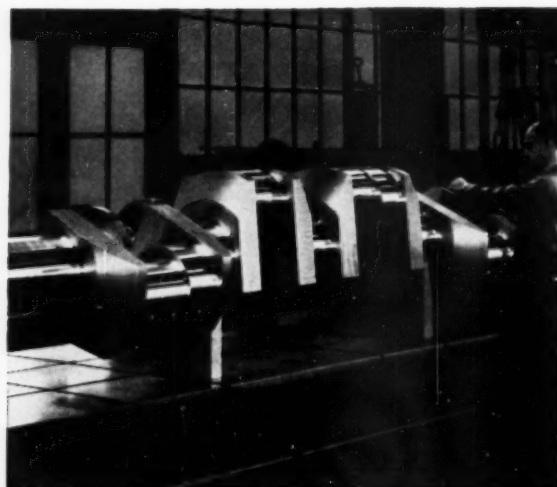
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NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture. So-called grease imitations of NON-FLUID OIL often prove dangerous and costly to use.



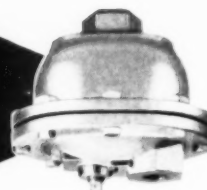
**WHO FORGES  
THE TOUGH CRANKSHAFTS ?  
.... and machines them, too**



**NATIONAL  
FORGE & ORDNANCE  
COMPANY**

IRVINE, WARREN COUNTY, PA.

**THE  
"NO-TROUBLE"  
AIR TRAP**



**THE ARMSTRONG NO. 21  
BALL FLOAT AIR TRAP —  
GUARANTEED TO SATISFY  
OR YOUR MONEY BACK**

For draining moisture from air lines, (drip pockets, small separators, small receivers, etc.) you can depend on the Armstrong No. 21 air trap for trouble-free service. It's built to the highest standards—guaranteed to satisfy. Can be used wherever no heavy oil or dirt is present. Check the features:

- **No Air Loss**—valve is always water-sealed.
- **Stainless Steel Parts**—float, leverage system and valve seat. Valve is heat-treated chrome steel.
- **Small, Compact**—Simple design, with a strong, cast semi-steel body.
- **Self-Priming**—no need to add water to start operation.

#### Bulletin Describes Complete Line of Armstrong Air Traps

Bulletin No. 2024 shows how to select air traps for any job. Gives dimensions, capacities and prices of all Armstrong air traps. For your copy, call your local Armstrong Representative, or write:

8853 Maple St., Three Rivers, Michigan



**ARMSTRONG MACHINE WORKS**



## SAVING WITH AIR POWER

### *Application:* Securing Pipeline Bolts

A CONSTRUCTION company in Oklahoma contracted the job of laying some 25,000 feet of cast iron pipe to be used as a water line. Each section of the pipe was 18 feet long, and the joints holding the hundreds of pieces of pipe together posed a real problem. Each joint had several bolts to be tightened—in all, there were more than 15,000 fasteners. According to the contract, each was to be run to a torque of 60 foot-pounds.

The construction concern had previously used a standard Ingersoll-Rand air-operated Impactool for this type of job, but decided to utilize a torque-control variety this time, because of the 60-foot-pound specification. The contractor obtained a Size 5040T torque-control Impactool and adjusted it to tighten the bolts to specification.

The new tool eliminates all the guess work involved in running down the nuts on the thousands of bolts. This Impactool has a special torsion bar section between the socket and the air driver which can be set to a preselected torque. When this foot-pound setting is reached, the tool shuts off automatically. Work goes smoothly because the operators know that each nut is fastened to the correct tightness.

This torque-control Impactool also made work go faster. An on-the-job time study revealed that an average of 10 minutes per joint was saved with the new air impact wrench. In the entire 25,000 feet of pipeline, there was a total



#### PIPE JOINT

Operator uses an Ingersoll-Rand Size 5040T torque-control Impactool for tightening bolts on a cast iron water pipe connection. By eliminating 10 minutes work per joint, the tool saved more than \$400 in the pipeline's 1390 joints.

of 1390 joints. The saving of 10 minutes per joint meant that more than 231 man-hours were saved by the controlled-torque wrench. At the hourly wage rate of \$1.75, this translates into a savings of \$404.25.

An added advantage was gained because of the compactness of the 5040T. Its small size allowed closer accessibility to the bell joints, so less time and effort were needed both for excavating and replacing the earth around the line.

### *Application:* Stand-By Latex Agitation



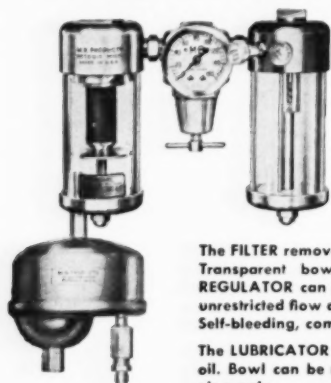
A LARGE chemical concern has a plant in western United States for the manufacture of raw synthetic rubber. At this installation, there are some 48 reactor agitators that mix several chemicals to produce latex. These agitators, important machines in the process, are normally powered by 10-hp electric motors that operate continuously. Because of the possibility of power failure, the chemical company wanted auxiliary power units to drive the reactor agitators while a short-stop chemical was added to the precious mixture to halt the reaction.

For this stand-by application, four Ing-

ersoll-Rand Size 2XM air drills were obtained. They were equipped with a special 1-inch square adapter. In the event of a power failure, an operator holds a drill over the electric motor drive shaft as seen in the photograph at the left. The drill turns the reactor agitator until the short-stop chemical has been added and stopped the process. The air-powered drill is a compact, powerful and lightweight unit that keeps the agitator operating steadily at the correct speed. For the chemical company, this means that a critical process is correctly controlled by air power until normal power is restored to drive the agitators.

## GREATER PROTECTION to your AIR LINE! **M-B**

**WHIRL-A-WAY FILTER, REGULATOR  
AND LUBRICATOR ASSEMBLY AND  
AUTOMATIC AIR TRAP (MODEL W-4)**



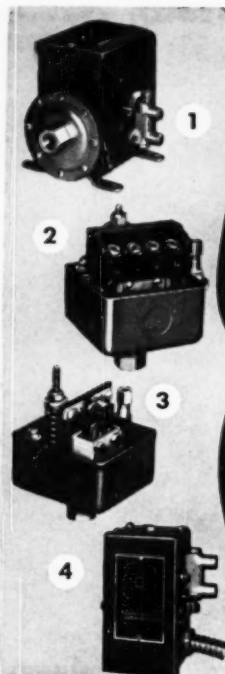
The Air Trap is automatic and eliminates manual draining.

**SUCCESSFULLY  
USED FOR  
PROTECTION  
OF AIR VALVES  
CYLINDERS  
CONTROLS  
PNEUMATIC  
TOOLS, ETC.**

The **FILTER** removes solids .00039 and larger. Transparent bowl provides visibility. The **REGULATOR** can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The **LUBRICATOR** delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

**M-B PRODUCTS**  
46 VICTOR AVE., Div. 14  
DETROIT 3, MICHIGAN



## SQUARE D

**FOR A  
Complete Line  
OF H.P. RATED  
AIR COMPRESSOR  
SWITCHES**

- 1** Heavy Duty
- 2** Standard Duty
- 3** Gas Engine Cut-Out
- 4** Magnetic Unloader

full range of electrical  
and pressure ratings

Write for Bulletin 550,  
Square D Company, 4041 North  
Richards St., Milwaukee 12, Wis.

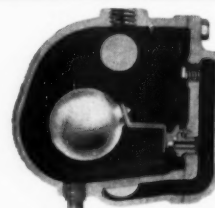
ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS



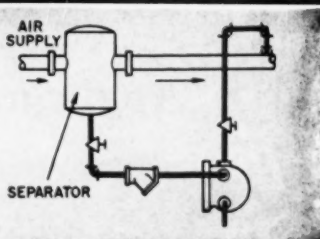
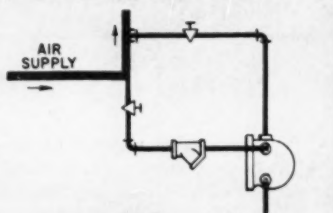
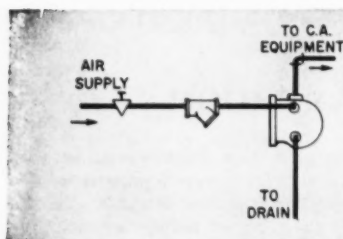
**SQUARE D COMPANY**

## INSTALL NEW SARCO FA DRAIN TRAPS

*and get more work from your CA tools*



Cross-section of Type FA Drain Trap showing float design that keeps condensate level above trap, providing seal against air leakage.



TYPICAL HOOK-UPS

The typical hookups illustrated here will help you get more useful work from your compressed air tools. Sarco Automatic Drain Traps keep condensate level in trap body above the valve. That maintains a positive seal against air leakage and gives you a steady supply of dry air. Dry air saves maintenance, too, and prevents dam-

age to tools from impaired lubrication and waterhammer. It avoids slowed-down production resulting from freezing in tool exhaust.

Write for "Literature Kit 6A" and get bulletin full of ideas to help increase effectiveness of your present air compressor capacity.

5892-F

**SARCO**  
COMPANY, INC.

635 Madison Ave., New York 22, N. Y.

DRAIN TRAPS • COOLING CONTROLS • SAFETY CONTROLS • IMMERSION THERMOSTATS • STEAM TRAPS • STRAINERS • HEATING SPECIALTIES





## Industrial Notes

**PUMPS** built for the pulp and paper industries are comprehensively described in a 24-page bulletin published by Ingersoll-Rand Company. The bulletin, Form 7296, contains a handy table for matching each paper service with the several models of I-R pumps designed to handle that service. In all, seven general pump types are detailed. Each description points out important design features and has cross-sectional and installation illustrations, as well as a listing of heads, capacities and discharge sizes. These pumps are included: paper stock pumps, with either conventional impellers, or diverging impellers for handling heavy stock or stock containing air or vapor; single-stage double-suction pumps for general, plant process and fan pump uses; single-stage and 2-stage cradle-mounted pumps for many services where low or medium capacities are needed; corrosion-resistant chemical pumps of Ircamet, a high nickel-chromium-molybdenum steel; high-capacity, horizontal propeller pumps, for low-head circulating services and other uses; multistage pumps for boiler feeding and debarking; and space-saving vertical pumps, with heads of a few feet to many hundreds of feet. Form 7296 may be obtained by writing to the manufacturer. *Ingersoll-Rand Company*, 11 Broadway, New York 4, N. Y.

**VALVES** and strainers for working pressures to 150 psig and temperatures to 75°F are now available in 1/4-, 3/8- and 1 1/4-inch sizes from Walworth. This makes the company's line of the rigid PVC (polyvinyl chloride) fittings complete in sizes from 1/4 to 2 inches. Plans are being made to add a 3-inch size. The fittings are said to offer exceptional resistance to inorganic salts, alkalis and acids, and other corrosive fluids in chemical, petrochemical and like industries. *Walworth Company*, 750 Third Avenue, New York 17, N. Y.

**HYDRAULIC** presses of the high-speed, open-gap and column types that range in capacity from 1 to 150 tons and can be used for forcing, straightening, trimming, molding, bending and press-fit assembling are discussed in Bulletin

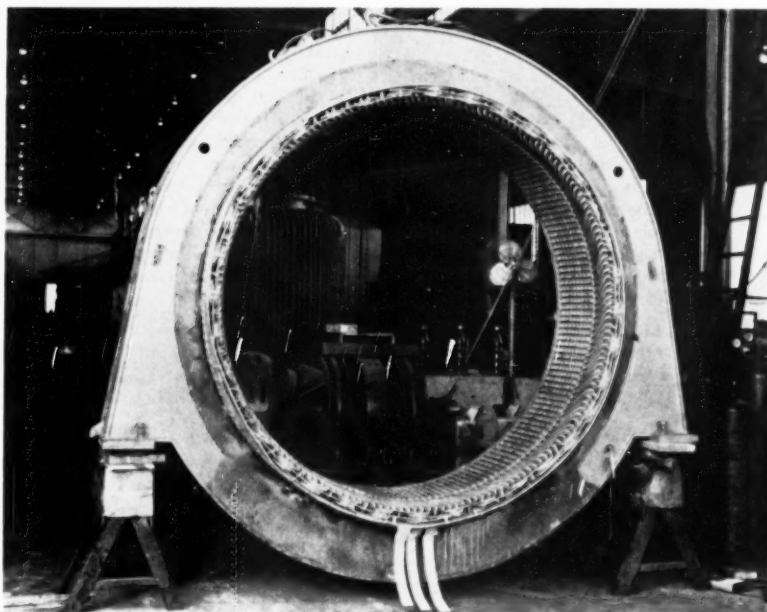
No. 130-G. A section containing engineering formulas useful in selecting the proper press for a specific application is also included. *Hannifin Company*, 501 S. Wolf Road, Des Plaines, Ill.

**LOCTITE** is a thin liquid that when confined between metal surfaces in the absence of air forms a tight seal. No heating or mixing of the material is required. Loctite impregnates joints with solid, void-free plastic. As long as any sealant outside the joint remains liquid, it may be wiped away with a degreasing solvent. Joints sealed with the material can be broken without difficulty with the usual precautions taken to insure a good wrench grip. No solid particles

are contained in the product that might enter the gas stream and foul valve operation. When hardened, the material is said to be unaffected by water, fuels, hydraulic fluids, degreasing solvents and most chemicals. It withstands heat to 300°F, and has been successful in sealing against carbon dioxide, oxygen, Freon, nitrogen, acetylene and liquid petroleum gases. As an example of its use (see illustration), the C. A. Norgren Company of Englewood, Colo., uses Loctite to seal against high pressure carbon dioxide (up to 3000 psig) in the concern's line of pressure regulators. *American Sealants Company*, 423 Woodbine Street, Hartford 6, Conn.



### PROTECTED MOTOR WINDINGS



Field windings of a 2500-hp compressor-drive motor at the Fontana, Calif., plant of Linde Company, Division of Union Carbide Corporation, are protected by Epoxylite molded-form coils. The coils' insulation is based on Bakelite brand epoxy resins. Previously, conventional insulation in these 24-pole motors was attacked by oily foreign matter. Particles in the air accumulated on the insulation, thus causing a building up of heat that sapped power and eventually resulted in coil failure. Consequently, insulation service life was short and down time was considerable. The new insulation is not affected by oil and it dissipates heat quickly. No heat trapping pockets exist and there are no capillaries for moisture or solid articles to penetrate.

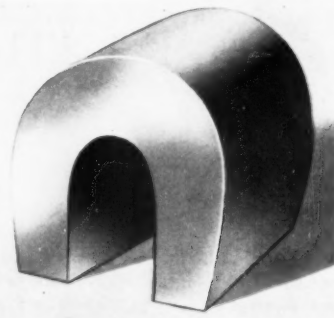
**F**OUNDRIES and forging shops will find useful a line of stencil inks for applying customer names, addresses and order numbers to castings and forgings, as is being done in the accompanying



photograph. The inks, dispensed from aerosol containers, eliminate the use of labels and tags which are easily lost in transit. Nine colors are available and the inks are said to dry almost immediately, are weather- and waterproof and will not rub off. *Reynolds Ink, Inc.*, 4500 Euclid Avenue, Cleveland 3, Ohio.

**L**OCATING pipes in walls or floors of industrial plants and retrieving tools from holes, wells, pits and other inaccessible places are some jobs that two sizes of magnets can perform. One is a 5-pound horseshoe-shaped type measuring  $3\frac{1}{4} \times 2\frac{5}{8} \times 2\frac{1}{4}$  inches. Its strength is

about 2000 Gauss and it will lift more than 125 pounds. The second size weighs

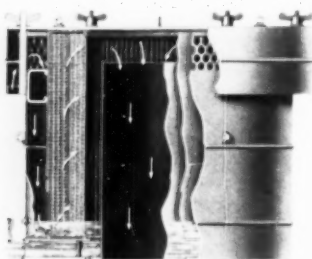


15 $\frac{3}{4}$  pounds and is  $5\frac{3}{16}$  inches high. Its Gauss rating is 5000-6000 and it will lift more than 250 pounds. Other tasks for the magnets include the magnetizing of tools and separation of scrap metals.

*Edmund Scientific Company*, Barrington, N. J.

## OIL BATH AIR FILTER

for engines, compressors and blowers



The Air-Maze Type F filter provides efficient removal of fine dirt from intake air to reduce wear on engine, compressor or blower parts.

High dirt removal efficiency is attained through its thorough scrubbing action.

This scrubbing action

is created by directing dirt-laden air into intimate contact with an oil pool. A "manometer" action created by the air passing a continuous baffle within the pool, causes more oil to be re-cycled than on other types of filter designs. Any dirt that remains in the air is then impinged on metal baffles. The metal baffles are kept clean by constant wash of the oil bath.

Flexible in design, the Type F filter can be furnished with top or bottom outlets, with or without relief valves to handle compressor unloading or line surges. Where noise reduction is a factor, the filter can be furnished with silencing chamber.

Available in sizes from 20 to 6650 cfm. Write *Air-Maze Corporation*, Cleveland 28, Ohio. Dept. CA-5.

# AIR-MAZE

**The Filter Engineers**

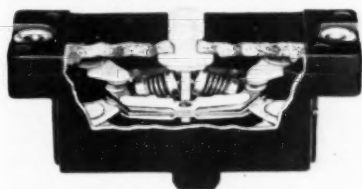
AIR FILTERS • SILENCERS • SPARK ARRESTERS • LIQUID FILTERS  
OIL SEPARATORS • GREASE FILTERS



"Why yes—I think with very little modification we could add a small crane boom to it."

power regulator. The self-contained throttle valve mechanism can be quickly removed from the handle without disturbing any other part of the tool. A sturdy beehive-type chisel retainer holds accessories securely, eliminating danger of carelessly discharging the chisel from the tool. The MC121 A2 Impact cutter kit, packaged in a handy metal carrying case, consists of the tool and six chisels. Additional accessories are also available. Form 5255 describes the tool. *Ingersoll-Rand Company*, 11 Broadway, New York 4, N. Y.

**P**RECISION limit switches utilize a contact mechanism that reportedly provides longer electrical and mechanical life as well as superior operating characteristics. The small, heavy-duty switches have a movable contact assembly with two compressed coil springs to provide quick opening and closing. A leaf spring, carrying the contacts, sup-



plies contact pressure, eliminates points of zero-contact pressure and provides a sure, but slow, operating motion. Completely enclosed in an arc-resisting, molded phenolic case, the switches have an electrical rating of 600 v. A variety of operators, such as plunger, roller and cabinet door types, is available for use in combination with the basic switch.

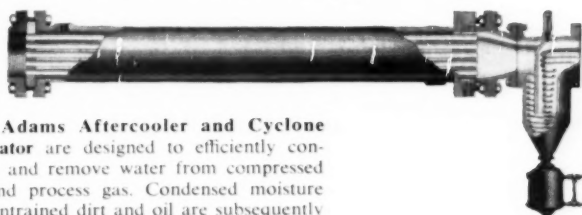
*Cutler-Hammer Inc.*, 221 N. Twelfth Street, Milwaukee 1, Wis.

**P**UBLICATIONS of Minneapolis-Honeywell's Industrial Division are presented in an index of literature. The 24-page bulletin, G2-1a, lists product catalogs, specifications, technical bulletins, industry bulletins, systems bulletins and instrumentation data sheets. An alphabetical subject-company index of magazine articles in *Instrumentation*, the company's magazine, is also included. *Minneapolis-Honeywell Regulator Company*, Wayne and Windrim avenues, Philadelphia 44, Pa.

**T**UNGSTEN carbide abrasives are available for use with stationary and portable air and electric tools and with hand tools. Reportedly, the manufacture of the abrasives proceeds under carefully controlled conditions, with use being made of various grit sizes of dia-

## Aftercooler and Cyclone Separator designed for cleaner, dryer compressed air

R. P. ADAMS CO., INC.  
209 East Park Drive, Buffalo 17, New York



The Adams Aftercooler and Cyclone Separator are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

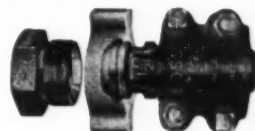
Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm

where it is necessary to cool within 2° F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases the maximum pressure loss at rated capacities is ½ psi.

This wide range of sizes enables the economical utilization of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.



## "GJ-BOSS" GROUND JOINT, STYLE X-34 HOSE COUPLING



The female-type coupling you can rely on for tight, safe connections on the big drills, manifolds; jumbos; in caisson work; and all other high-pressure operations. Copper insert in spud fits rounded head of stem, forming soft-to-hard, leakproof metal seal. "Boss" Offset Interlocking Clamp provides powerful grip on the hose—proof against blow-offs. Also available in washer type, and with companion male coupling. Sizes ¼" to 6".



## "BOSS" HOSE MENDER STYLE BM-16

The practical, safe way to quickly restore damaged hose to service. Complete fitting consists of mender tube and two "Boss" Interlocking Clamps. Tube has flanges to engage clamp fingers. Tube shanks have well-defined, smooth corrugations. Thoroughly rustproofed. Sizes ½" to 6".

Stocked by Manufacturers and Distributors of Industrial Rubber Products

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Valve & Coupling Co.  
GENERAL OFFICES & FACTORY—PHILADELPHIA 22, PA.  
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DIXON VALVE & COUPLING CO. LTD. TORONTO Associate Companies  
Rock Iron Company Inc. Garyville, Pa. Precision Brass Steel Company, Camden, N.J.



## HOSE COUPLINGS

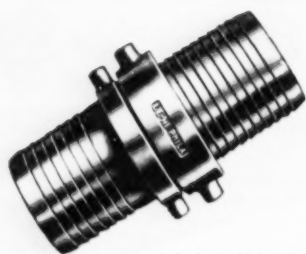
FOR EVERY  
APPLICATION



STEAM



AIR



WATER

WRITE FOR BULLETIN 34

**HOSE ACCESSORIES  
COMPANY**

PHILADELPHIA 32, PENNA.

mond-hard tungsten carbide and fine carbon steel. Carbraze, as the product is called, is said to be very versatile. It serves as cutting wheels for portable, table and radial saws; disks for floor edgers and sanders, strips for files and sheets for sanding. Sheets as large as 16x58 inches have been produced.

Carbraze, Inc., 2556 Edgington Avenue, Franklin Park, Ill.

FOR pneumatic and low-pressure hydraulic lines, H-52 swivels are available for hose with inside diameters ranging from  $\frac{3}{16}$  to  $\frac{3}{8}$  inch, and outside diameters, from  $\frac{3}{8}$  to  $\frac{3}{4}$  inch. The all nickel



and chrome plated units incorporate a unique method of making the swivel con-

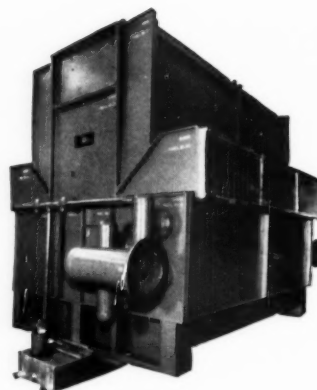
nection. Instead of the swivel portion being held by the usual flange and lip construction, a stainless steel wire gasket is inserted through the swivel head and seals the fitting, as can be seen in the illustration. According to the manufacturer, the connection assures an absolutely leak- and vibration-proof fitting; and the strength of the fitting is increased, thereby eliminating 90 percent of breakage. *Hofmann Engineering Company, 4022 W. Fifty-fifth Street, Chicago 32, Ill.*

UNPIGMENTED paints, primers, lacquers and the like can be dispensed directly from the 2-inch end bungs of shipping drums by use of an air-powered pump. The 17½-pound unit reportedly will move up to 120 gallons per hour in a normal circulating pump system, and will feed as many as five spray guns. The pump is also useful for direct-supply applications in production and maintenance painting. A 3-tube design separates the air motor from the pump assembly, thereby eliminating any chance of the fluid fouling the power head. Two tubes are used for supply and the third returns paint to the drum, providing continuous circulation. Being air-powered, the unit is free from any sparking hazards. An adjustable bung adapter permits its use in 55-gallon drums of vary-

## ECONOMICAL COOLING OF GASES AND COMPRESSED AIR

Cooling gases or cooling and removing moisture from compressed air, the Niagara Aero After Cooler offers the most economical and trustworthy method. Cooling by evaporation in a closed system, it brings the gas or compressed air to a point below the ambient temperature, effectively preventing further condensation of moisture in the air lines. It is a self-contained system, independent of any large cooling water supply, solving the problems of water supply and disposal.

Cooling-water savings and power-cost savings in operation return your



equipment costs in less than two years. New sectional design reduces the first cost, saves you much money in freight, installation labor and upkeep. Niagara Aero After Cooler systems have proven most successful in large plant power and process installations and in air and gas liquefaction applications.

Write for Descriptive Bulletin 130.

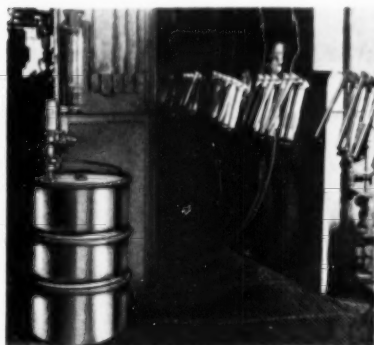
**NIAGARA BLOWER COMPANY**

Dept. CA-5, 405 Lexington Ave., New York 17, N. Y.

Niagara District Engineers in Principal Cities of U. S. and Canada



ing height. The pump has an air regulator to govern operating speed. Out-



let pressure of the pump is said to be approximately twice that of incoming air pressure. *Gray Company, Inc.*, 1021 Sibley Street N. E., Minneapolis 13, Minn.

**P**RESSURE regulators of the cylinder, manifold and station pressure types are described in a 36-page catalog. The booklet is illustrated and includes flow and pressure specifications, as well as inlet and outlet connection dimensions for each regulator. Described in detail are adapters, station valves, flowmeters, hose connections and pressure gauges. A copy of the catalog (Form ADC 705F) may be obtained free of charge. *Air Reduction Sales Company*, division of *Air Reduction Company, Inc.*, 150 E. Forty-second Street, New York 17, N.Y.

**A**IR-powered and other types of torque wrenches, as well as wrenches having devices for their own torque control, can be tested by a Torque Wrench Tester, the subject of a recently published catalog sheet. The self-contained



"Not very good, but he's really a steady worker."

## MORE POWER—BROADER LINE—CONTINENTAL IN '59



# GOOD RULE TO FOLLOW WHEN BUYING MATERIALS HANDLING EQUIPMENT

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Builder Thinks Enough Of  
His Own Good Name to  
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# VICTAULIC<sup>®</sup>

## METHOD OF PIPING

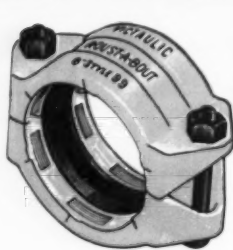


**VICTAULIC HAS EVERYTHING...**



### VICTAULIC COUPLINGS

Simple, fast, reliable. Styles 77, 77-D, for standard uses with steel or spiral pipe, — Style 75 for light duty. Other styles for cast iron, plastic and other pipes. Sizes  $\frac{3}{4}$ " to 60".



### ROUST-A-BOUT COUPLINGS

For plain or beveled end pipe Style 99. Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 12".



### VICTAULIC SNAP-JOINTS

The new, boltless, speed coupling, Style 78. Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

**COUPLINGS FOR EVERY PIPING JOB**



### VICTAULIC FULL-FLOW FITTINGS

Elbows, Tees, Reducers, Laterals, a complete line—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes  $\frac{3}{4}$ " to 12".



### VIC-GROOVER TOOLS

Time saving, on-the-job grooving tools. Light weight, easy to handle — operate manually or from any power drive. Sizes  $\frac{3}{4}$ " to 8".

**PLUS FITTINGS AND GROOVING TOOLS**

**"EASIEST WAY TO MAKE ENDS MEET"**

Promptly available from distributor stocks coast to coast.  
Write for NEW Victaulic Catalog-Manual No. B-5

**VICTAULIC COMPANY OF AMERICA**  
P. O. BOX 509 • Elizabeth, N. J.

tester, said to be a precision instrument, is certified by the manufacturer as being accurate within 1 percent of full-scale reading. Because the unit is portable, it may be mounted on any bench or clamped into a vise; it can be read on both right and left sides. The catalog sheet provides detailed specifications and application information for six models.

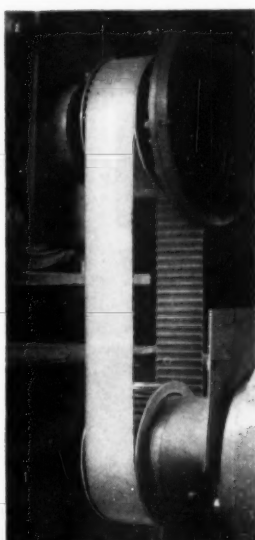
Skidmore-Wilhelm Manufacturing Company, 442 Green Road, Cleveland 21, Ohio.

## Books...

*Selection And Evaluation Of Rare And Unusual Metals For Application To Advanced Weapons Systems* (Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.) surveys literature published by the U. S. Air Force about the rare metals hafnium, rhodium and ruthenium. Such exotic elements as these are receiving increasing use in technology because of their high temperature properties, useful in advanced weapons systems. The book discusses the abundance and distribution of the rare elements, and methods of recovery, purification and reduction to metal. Their physical, chemical and mechanical properties are given. Potential uses of the rare earths in both metallic and nonmetallic forms, are considered from production and economic viewpoints. The report lists a bibliography of 752 references giving information about the elements. Containing approximately 100 tables and illustrations, the survey is designated PB 151311. 185 pages. Cost, \$3.

*Compilation of ASTM Standards On Cement* (published by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.) is said to be valuable to engineers, agencies and laboratories concerned with the national highway construction program, and to users of cement in concrete buildings and other structures. The refinement of the standards by the ASTM Committee C-1 on Cement includes the bringing up-to-date of 15 of the 34 standards in the volume. Of particular interest are the revisions in the "Specifications For Portland Blast-Furnace-Slag Cement (C 205)" and the "Methods Of Sampling Hydraulic Cement (C 183)." In addition to the specifications, methods of test and definition of terms, appendices contain a "Manual Of Cement Testing" that has information to assist the plant chemist in making cement tests. Also, there are a list of selected references and a discussion of analytical balances and weights. This edition, the thirteenth, supersedes the 1957 one and is paperbound. 278 pages. Cost, \$3.50.

**Simple, Dependable, Low-Cost  
Wood's "Timing" Belt Drives  
Have Nearly 100% Efficiency**



Wood's "Timing" Belt Drives offer outstanding solutions to a wide variety of drive problems. They are simple and compact in construction, provide instantaneous, slip-free response; require no lubrication... no take-up devices; and eliminate belt matching. Their speed range is exceptional... from 0 to 16,000 fpm. Load capacities range up to 600 hp and above. Continuous, helically wound steel cables are imbedded in tough, neoprene, nylon-faced belts. You'll find many other cost-saving advantages in addition to technical data in Wood's Catalog 2100.

**T. B. WOOD'S SONS COMPANY**

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ATLANTA • CAMBRIDGE • CHICAGO • CLEVELAND • DALLAS • NEWARK

*protect your equipment*

with **DRI Air**

A complete, self contained unit that collects and automatically ejects water and oil from air lines.

Dri Air collects dirt and rust thereby reducing wear and prolonging tool life.



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all types of industries use

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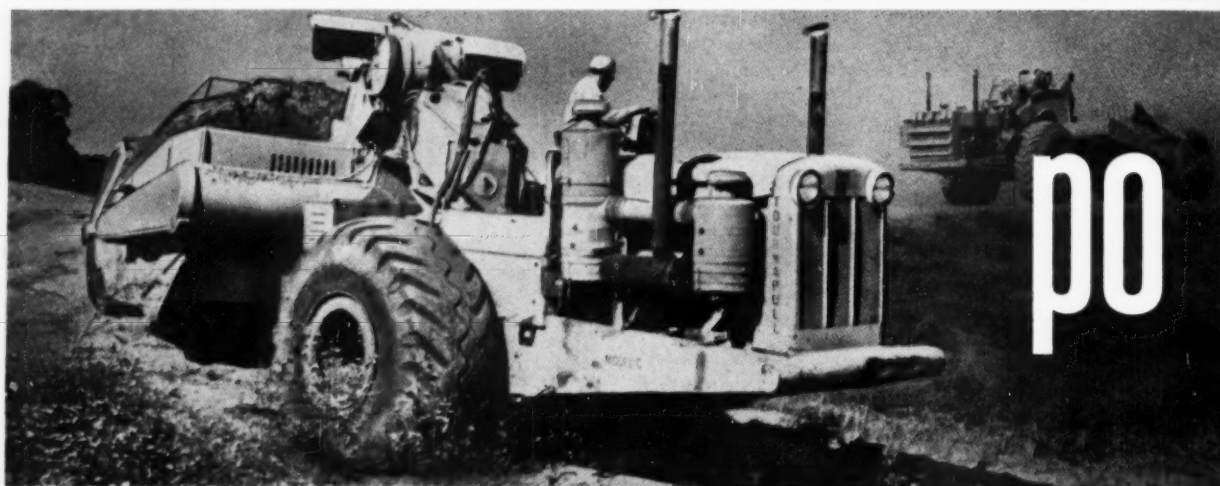
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ALL-PURPOSE  
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20 to 1650 H.P.  
in only 3 cylinder sizes



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20 to 47 H.P.



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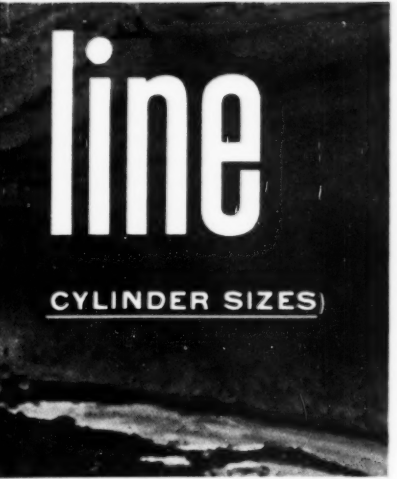




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Now, whatever the equipment, whatever the contract calls for, there's a "Jimmy" Diesel tailored to it.

So now every contractor can standardize on GM Diesel power and buy the finest equipment available.

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112 to 232 H.P.



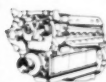
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identified by the blue band

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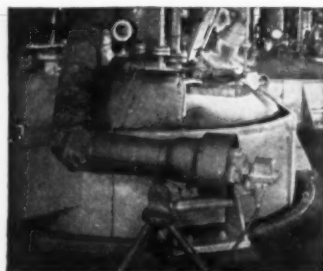
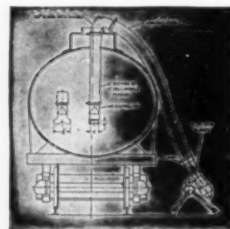
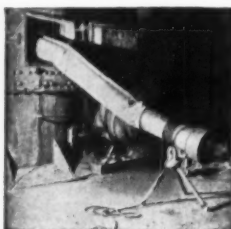
## VANO Design "A" VENTILATOR



Vano Design "A" cooling interior of furnace, supplying fresh air through 10 feet of "Ventube" to provide safety and comfort during repair work.

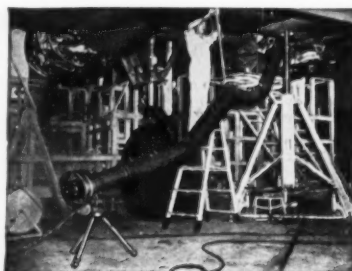
Vano Design "A" delivering fresh air to cable manhole, expelling sewer gas, making entrance safe in a few minutes.

Vano Design "A" Ventilator plus a few accessories feeds large air volume into tank car, driving out fumes, stagnant or hot air for workers' safety and comfort.



Vano Design "A" supplying fresh air in Reactor Room of Synthetic Rubber Plant.

Vano Design "A" Ventilator supplying fresh air to men working in wing compartments and fuselages, etc.



Powered by a 1/2 hp motor, and equipped with the exclusive Coppus axial-flow propeller-type fan, this general-purpose blower delivers 1500 CFM of fresh air. It supplies ventilation for tanks, tank cars, drums, vats, underground cable manholes, pipe galleries, airplane wing compartments and fuselages, and other confined places. Weighs only 103 lbs. Uses 8"-diameter flexible canvas tubing ("Ventube").

### VANO DESIGN "C"

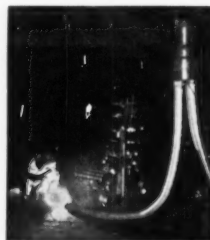


VENTILATOR-EXHAUSTER



Vano Design "C" equipped with 8" discharge tubing removing welding fumes.

Vano Design "C" equipped with two suction lines removing welding fumes for operators' safety.



For withdrawing welding fumes from confined places or directly from the welding rod ... or for expelling fumes or hot air from enclosed vessels. You can get it with 8" suction inlet for 8" non-collapsible tubing ... or with multiple inlet nozzles for 5", 4" or 3" suction hose. The discharge outlet takes 8" "Ventube". Powered by a 1/2 hp motor, it weighs only 85 lbs.

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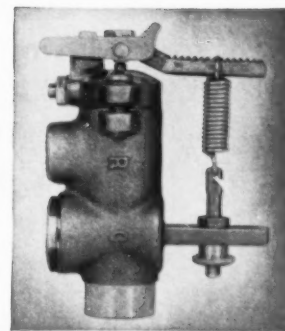
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By A.J. Stepanoff, Ingersoll-Rand Company, Development Engineer

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Revised and expanded to reflect the significant advances in recent years in the field of centrifugal pumps, this book provides a modern treatment of the whole field. Includes a method of attack based on: a single pattern of flow; identical theoretical reasoning; and similar design procedure for centrifugal, mixed flow, and axial flow pumps.

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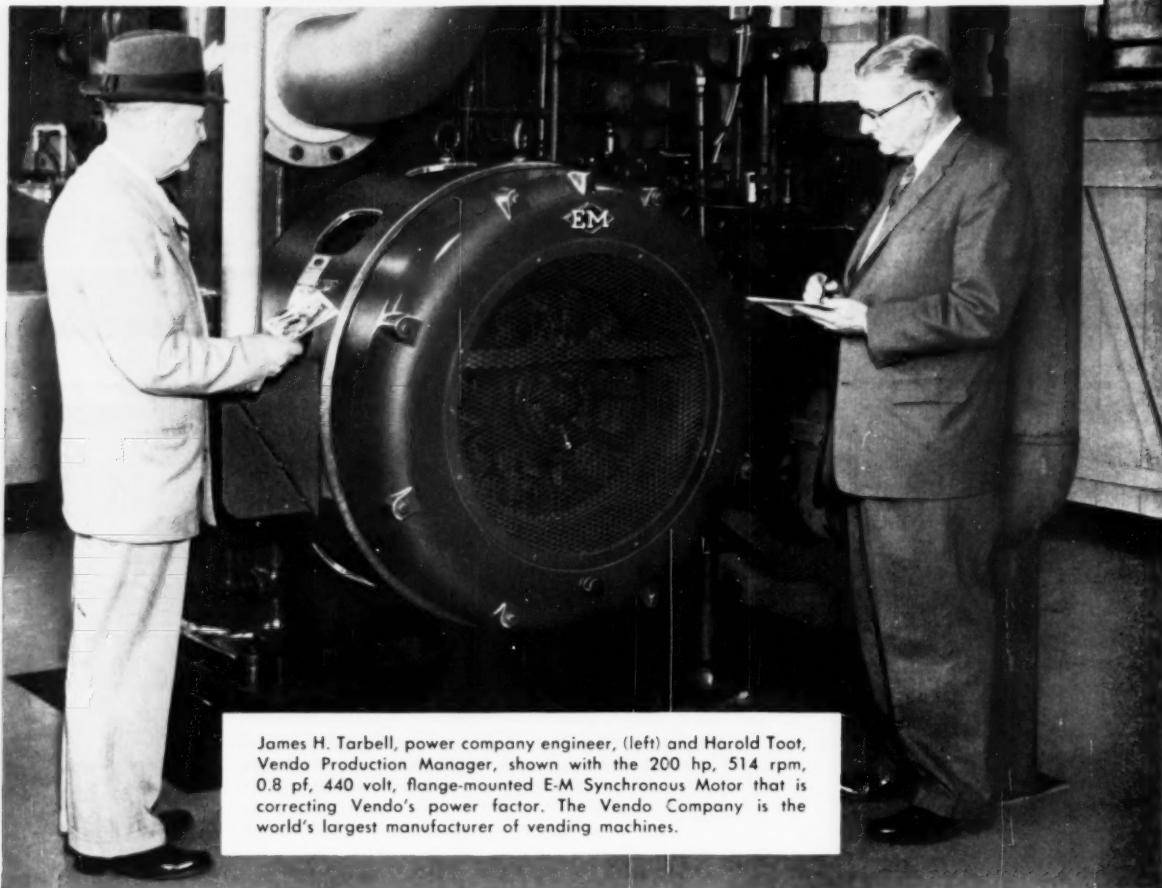
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## ADVERTISERS INDEX

Adams Company, Inc., R. P. . . . .	39	Eimco Corporation, The . . . . .	7
Air-Maze Corporation, The . . . . .	38	Electric Machinery Mfg. Company . . . . .	48
Allen-Bradley Co. . . . .	2nd Cover	Garlock Packing Company, The . . . . .	3rd Cover
Armstrong Machine Works . . . . .	34	General Electric Company . . . . .	8
Band-It Co. . . . .	43	Hose Accessories Company . . . . .	40
Bethlehem Steel Company . . . . .	9	Ingersoll-Rand Company . . . . .	4, 5, 10, Back Cover
Combustion Engineering . . . . .	11	M-B Products . . . . .	36
Commercial Filters Corporation . . . . .	6	National Forge Company . . . . .	34
Compressed Air Magazine Company . . . . .	47	Naylor Pipe Company . . . . .	2
Conrader Co., Inc. The . . . . .	47	New Jersey Meter Co., Inc. . . . .	43
Continental Motors Corporation . . . . .	41	New York & New Jersey Lubricant Company . . . . .	34
Coppus Engineering Corporation . . . . .	46	Niagara Blower Company . . . . .	40
Detroit Diesel Engine Division—		Sarco Co., Inc. . . . .	36
General Motors . . . . .	44, 45	Square D Company . . . . .	36
Dixon Valve & Coupling Co. . . . .	39	Victaulic Company of America . . . . .	42
Dollinger Corporation . . . . .	1	Wood's Sons Company, T. B. . . . .	43

## Are You Paying Big Penalties for Lagging Power Factor?



James H. Tarbell, power company engineer, (left) and Harold Toot, Vendo Production Manager, shown with the 200 hp, 514 rpm, 0.8 pf, 440 volt, flange-mounted E-M Synchronous Motor that is correcting Vendo's power factor. The Vendo Company is the world's largest manufacturer of vending machines.

## Vendo Company Corrects Power Factor...SAVES \$450 A YEAR! with an E-M Synchronous Motor

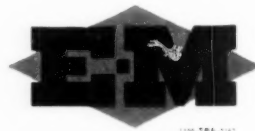
**T**he Vendo Company, Kansas City, Missouri learned its plant was operating at a lagging power factor condition when expanded production facilities required more compressed air. A study by Vendo's engineers and Kansas City Power & Light Company showed an 0.8 leading power factor synchronous motor compressor drive would save them money. Here's how:

Vendo's power contract provides a penalty of 20 cents a month for every reactive kva exceeding one-half the maximum kilowatt demand. *This was costing Vendo \$33.00 per month, or \$396.00 a year!*

A 20 cents a month bonus is granted for every kilovar the reactive demand falls short of one-half the maximum kilowatt consumption. A 200 hp E-M Synchronous Motor with 0.8 pf would provide enough reactive kva for Vendo to operate at a *leading* power factor and earn a monthly credit of \$4.60. Vendo's power bill would then be reduced by \$37.60 a month, or \$451.20 a year!

Vendo installed the recommended E-M Synchronous Motor... and has been enjoying a reduced power bill ever since. You, too, can make a big saving in your plant power bill by correcting your power factor with highly efficient E-M Synchronous Motors.

Learn more about Power Factor. Call your nearby E-M Sales Engineer and write for your free copy of the new E-M 24-page brochure, *The ABC of Power Factor*.



**ELECTRIC MACHINERY MFG. COMPANY**  
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*Specialists in making motors do*  
**EXACTLY WHAT YOU WANT THEM TO**



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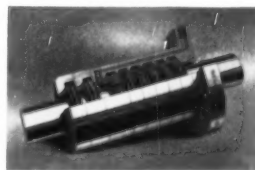
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... provides positive sealing at no extra cost

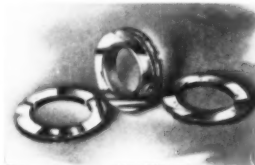
Now all Garlock Metal Scraper and Packing Rings have a surface finish of 10 micro-inches or less! And flatness of the rings is measurable in light bands; which means a more positive seal between ring and groove. This exclusive Garlock advantage has been made possible through improved manufacturing technique and is offered to you without additional cost.

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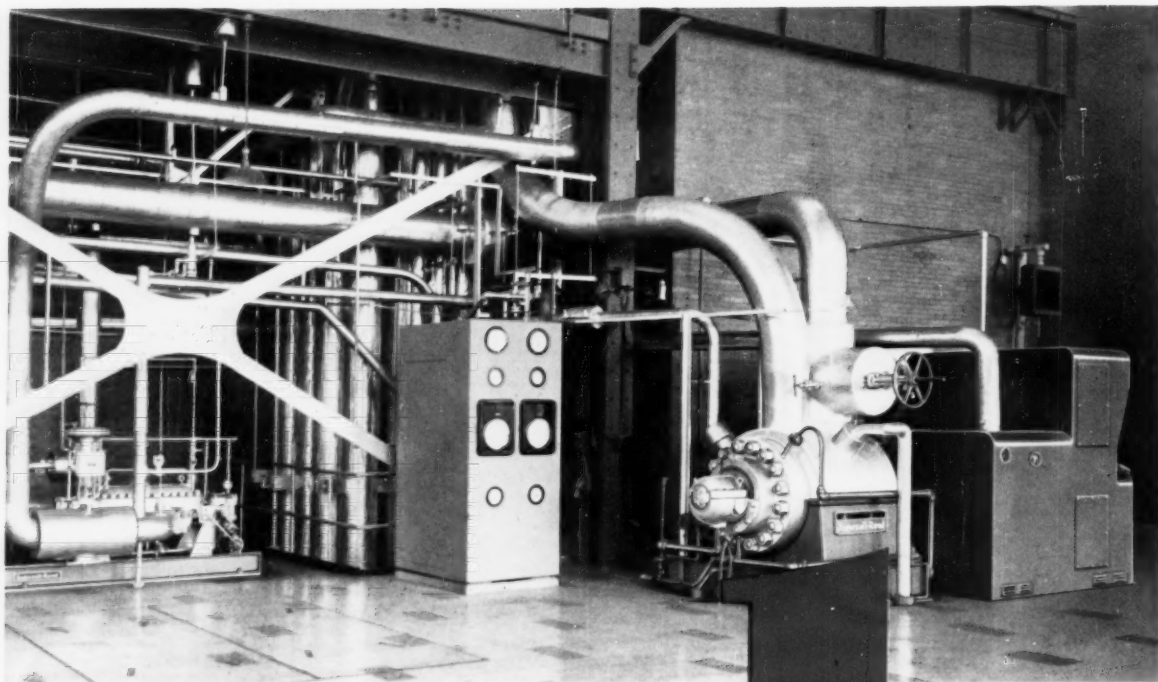
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## FULL-CAPACITY PUMPS... ONE per boiler

*I-R High-Speed Boiler-Feed Pump at Appalachian Power Company's Glen Lyn Station is the first of 8 Identical I-R Units installed on the American Electric Power System*

The Ingersoll-Rand boiler-feed pump shown above represents a radical departure from previous central station practice. Instead of the usual three-pump arrangement with two normally carrying full load, in this installation one main pump supplies all the feedwater required for the 225 MW Glen Lyn Unit No. 6. This unit first operated in May 1957. The last of seven more I-R full capacity boiler-feed pumps like the one shown above is currently being installed.

In addition to making important savings in first cost and operating cost, the turbine-driven full-capacity pump improves cycle performance and heat balance conditions by

using extraction steam from the main turbine to drive the pump and exhausting this steam to feedwater heaters.

Each pump, rated 1,500,000 lb hr at 2400 psig and 5400 rpm, is driven directly by a General Electric turbine. Pumps are of 4-stage, double-case construction with "Unit-Type" rotor assembly and floating-ring type stuffing boxes. Boiler start-up is handled by a smaller auxiliary motor-driven I-R feed pump, barely visible in the left background above.

In addition, American Electric Power will soon put into operation the world's largest boiler-feed pumps—two 22,000 hp I-R full capacity units serving new 450 MW generators at two AEP stations.

For further details on full-capacity boiler-feed pumps, or any other boiler-feed units, contact your Ingersoll-Rand sales engineer.



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